FISHERY RESEARCH

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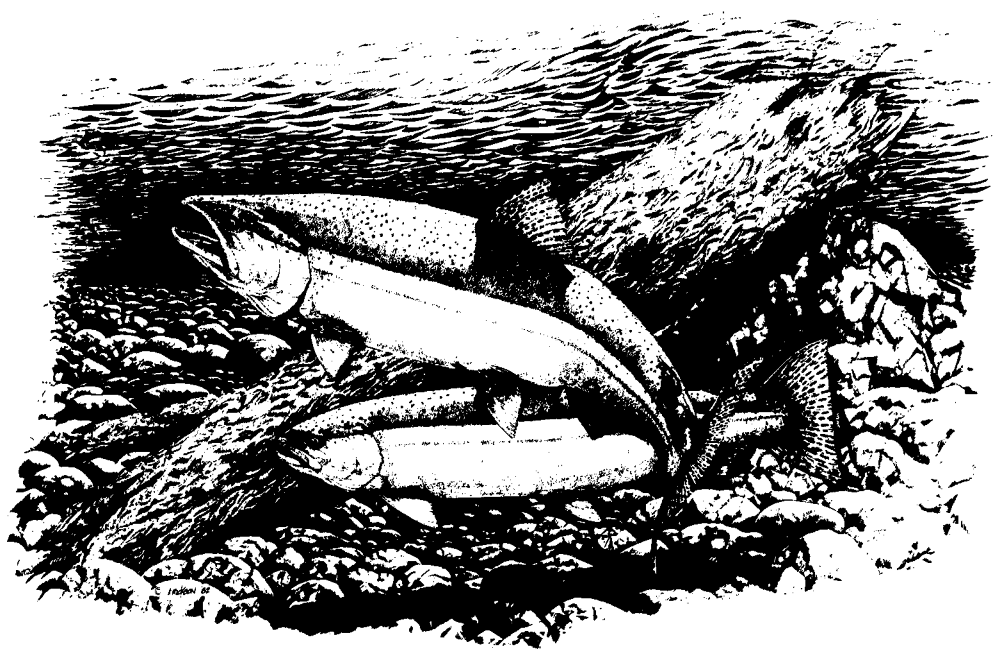

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ABSTRACT

The South Fork Salmon River (SFSR) formerly supported a substantial population of wild steelhead trout (*Salmo qairdneri*). As a consequence of severe habitat degradation in the SFSR, and the simultaneous effects of hydroelectric development on the Snake and Columbia rivers, this population has declined severely. The fishery for steelhead trout has been closed since 1968 in an attempt to sustain the remaining population.

In 1984, we began evaluating the status of wild SFSR steelhead and resident trout. We found a viable wild population of steelhead trout in the SFSR drainage. The fish appeared to be most similar to "B-stock" steelhead and averaged 87 cm in total length.

Differences in timing of spawning, and fluctuations in escapements between years, suggest that discrete spawning populations exist in individual mainstem areas and tributaries. An estimated 800 to 900 steelhead spawned in the SFSR in 1984 and 1985.

Steelhead trout parr rear in the mainstem SFSR also. Tributaries provide the principal rearing habitat for juvenile steelhead trout (parr) in the SFSR. All accessible stream reaches we surveyed supported steelhead parr.

Juvenile chinook salmon were most abundant in mainstem pools and runs and in low-gradient reaches of tributaries. Chinook were observed in seventeen tributaries. The SFSR supports fluvial and resident stocks of westslope cutthroat trout, as well as resident and fluvial stocks of bull trout.

Bank anglers fished an estimated 6,553 and 11,634 hours on portions of the SFSR from June 30 to September 21, 1984 and from May 25 to September 13, 1985, respectively. Steelhead trout parr comprised a majority of the fish harvested for 1984 and 1985 combined.

Preliminary electrophoretic analysis data suggest SFSR wild steelhead trout may be genetically isolated from Middle Fork Salmon River steelhead trout stocks. Within the SFSR, steelhead trout populations in Johnson Creek differed from those sampled in the Secesh River.

It is recommended that the SFSR drainage be managed for the production and preservation of the indigenous, wild stock.

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INTRODUCTION

The South Fork Salmon River (SFSR) is one of three major Idaho rivers currently managed for the production of indigenous, wild steelhead trout (Salmo qairdneri) (IDFG 1984). This research program was initiated in 1984 to evaluate the current status of wild steelhead trout and resident fish in the SFSR, and to recommend means of restoring the sport fishery.

Historically, the SFSR was the single most important summer chinook salmon (Oncorhynchus tshawytscha) spawning stream in the Columbia River drainage (Mallet 1974). Approximately 50% of Idaho's summer Chinook salmon redds were counted in the drainage. The SFSR also supported a steelhead trout run estimated at 3,000 or more (IDFG 1984).

An excellent chinook salmon and steelhead trout (steelhead) sport fishery existed on the SFSR. Nearly 31% of the state's chinook salmon angling, and 10 to 15% of the steelhead angling effort occurred on the river. Approximately 4,000 chinook salmon and 810 steelhead were harvested in 1960 and 1963, respectively (Richards 1961a, Ortmann 1966).

Since the 1940's, man-caused activities (primarily road construction and logging) have caused erosion of unstable soils and damage to aquatic habitat in the SFSR (Megahan et al. 1980, Platts and Martin 1980). Erosion of disturbed soils was initially reported in 1948. By 1965, 15% of the watershed area had been logged. Seventy-eight percent of the logging and 69% of the road construction occurred on steep, unstable stream-cut lands. Severe damage to aquatic habitat occurred in 1964 and 1965 as pools were completely filled with sediment. Spawning areas were buried under sand, and capacities of rearing areas were reduced (Corley 1976). Logging was suspended in the SFSR in 1965 and a rehabilitation program initiated.

Although improvements in fish habitat have begun (Megahan et al. 1980), a large quantity of interstitial fine sediment remains and most of the recovery has yet to occur (Burns 1984). The recommendation of Corley (1976) that "No management activity should be conducted in the South Fork drainage that will adversely affect the aquatic habitat or retard the rehabilitation rate in the river" still applies.

As a consequence of the severe habitat degradation, anadromous fish populations in the SFSR declined severely. Chinook salmon and steelhead fishing were closed in 1965 and 1968, respectively. The populations were simultaneously reduced by accelerated hydroelectric development on the Snake and Columbia rivers. It is believed that resident fish populations also declined as a result of the habitat degradation.

Initial work on this research project began on March 1, 1984 under Anadromous Fish Conservation Act funding. The Lower Snake River Fish and Wildlife Compensation Plan has provided funding since September 1, 1984. This report provides results from March 1, 1984 to February 28, 1986.

DESCRIPTION OF STUDY AREA

The SFSR flows through the central Idaho Batholith, an area of granitic bedrock characterized by steep slopes and highly erodible soils. From its origin, the SFSR flows north for 160 km through the Salmon River mountains and joins the Salmon River 77 km above Riggins, Idaho (Fig. 1). The watershed drains 3,290 km^2 and drops in elevation from 2,740 to 640 m.

Anonymous (1977) and Platts (1974) provide detailed descriptions of the study area's topography, climate, vegetation and geology.

Peak stream discharge occurs during a six-week period in May and June following snowmelt (Fig. 2). Base flows occur from September through January. The year of 1974 represents a high flow year and 1977 a low flow year. Between 1980 and 1984, mean annual flow near Krassel Ranger Station varied from 539 to 815 cfs (1 cubic foot = .0283 cubic meters) (US Geological Survey 1979 to 1983, Edwards 1986). Maximum discharge ranged from 3200 to 4900 cfs and minimum discharge from 80 to 170 cfs. The SFSR and tributaries have low nutrient concentrations. From 1979 to 1981, total dissolved solids averaged 48 mg/I in the fall, alkalinity averaged 24 mg/I and specific conductance averaged 56 umHOS.

Roads provide access to most of the SFSR and its major tributaries (East Fork of the South Fork, Johnson Creek and Secesh River). Mining of precious metals has significantly altered sections of the East Fork of the South Fork and its headwater tributaries (Desert Research Institute 1979). Placer mining was once common in the drainage.

OBJECTIVES

To determine the status of native SFSR steelhead.

To identify the genetic character of SFSR steelhead and compare to other Columbia Basin stocks.

To determine the distribution, timing and catch of SFSR steelhead in the mainstem Salmon River fishery.

To map principal anadromous and resident species' spawning areas in the SFSR and tributaries.

To assess the abundance and distribution of anadromous and resident species rearing in the SFSR and tributaries.

To provide recommendations for development of a steelhead fishery in the SFSR and major tributaries.

To provide recommendations for development of resident fisheries in the SFSR and major tributaries that would be compatible with anadromous fishery goals.

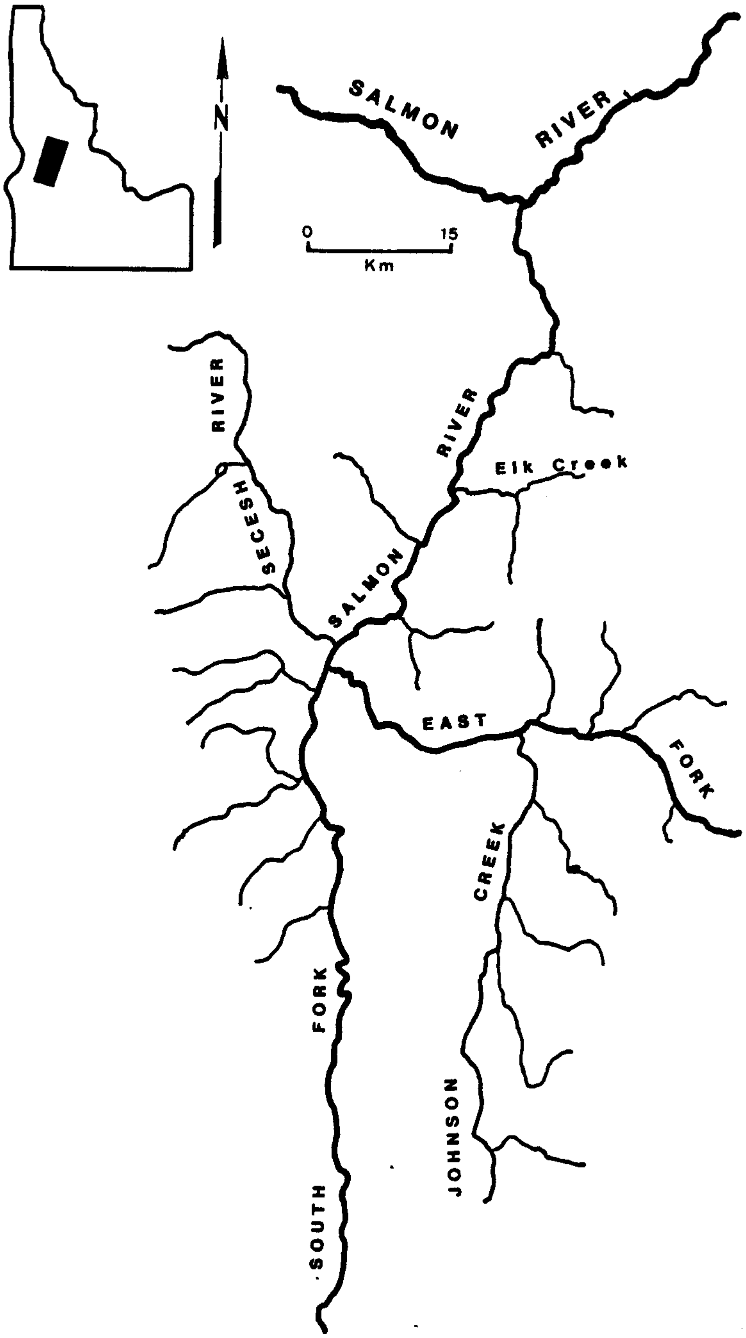

Figure 1. South Fork Salmon River drainage, Idaho.

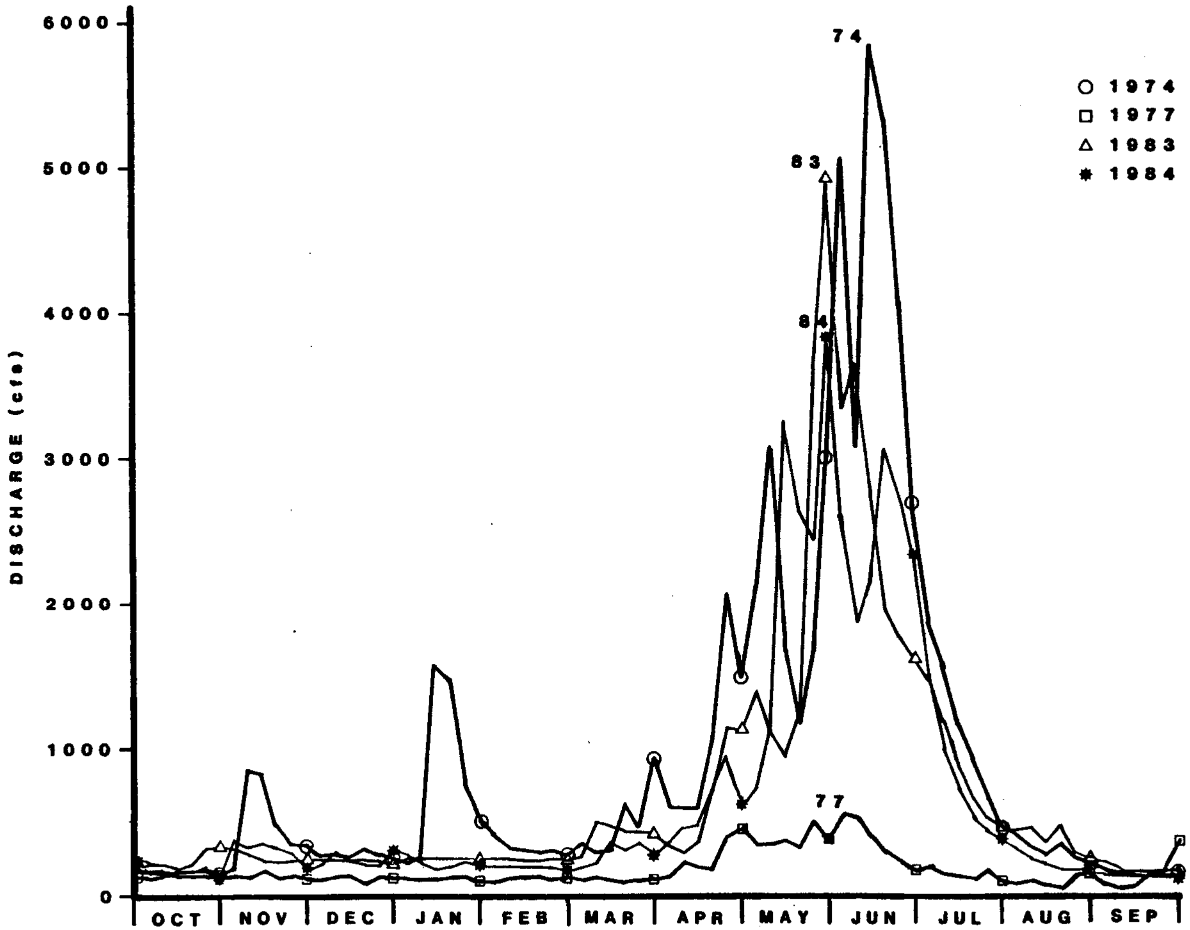

Figure 2. Discharge (cfs) of South Fork Salmon River near Krassel Ranger Station (gauge no. 13310700), 1974, 1977, 1983, 1984.

RECOMMENDATIONS

1. Wild steelhead trout stocks are unique. Their value is inestimable to future management of steelhead trout populations. The recommended alternative for restoration of steelhead trout sport fishing opportunities to the SFSR is management for production and preservation of the indigenous, wild stock.

2. A critical factor influencing restoration of SFSR anadromous and resident fish is habitat condition. Land management agencies should conduct activities in the SFSR drainage in a manner which will result in continued improvements in fish habitat potential toward an ultimate goal of not less than 90% of potential. To accomplish this goal, existing sources of sediment must be corrected and no new sediment-producing activities allowed. Where feasible, site-specific habitat restoration projects may be used to accelerate improvements.

3 Use embeddedness measurements for evaluating negative impacts of projects to fish habitat and for monitoring results of habitat restoration programs.

4. Obtain maximum production of steelhead trout by fully seeding the available habitat with steelhead trout parr. Under habitat conditions restored to 90 to 100% of potential, calculations based on the application of steelhead production data to available habitat suggest a spawning escapement goal of 4,000 steelhead trout to fully seed the habitat.

5. Catch-and-release regulations for cutthroat trout should be continued for a minimum of five years in order to monitor the populations response to decreased angling mortality and improved habitat condition.

6. Implement a 200 mm size limit to restrict the harvest of most steelhead trout parr and allow anglers to harvest residualized steelhead trout and trout of other species.

7. If catchable trout introductions are to be continued, more restrictive regulations may be necessary to reduce the harvest of wild trout.

8. Continued evaluation of the status of steelhead, cutthroat and bull trout populations should be accomplished according to the procedures outlined in Appendix A.

METHODS

Adult Steelhead Movements

Between September and March, 1984 and 1985, we captured and tagged adult steelhead in the SFSR and main Salmon rivers. We used barbless hooks to capture fish and attached numbered metal tags to their mandibles. All captured fish were anal fin punched, measured (total length), sexed and checked for marks, tags, or evidence of hatchery-rearing. We also experimented with "ribbon tags" (a flag of colorful ripstop nylon attached to the fish with a Floy tag). Ribbon tags were used so that individual fish could be observed at a distance with snorkeling gear or from the shore.

To obtain timing and movement data, we fished areas of the SFSR and tributaries. Snorkeling gear was used to observe adult steelhead staging in lower portions of the SFSR.

Spawning Area Surveys

From mid-March to the end of May, we annually surveyed sections of the SFSR and tributaries with ground and aerial counting methods. Stream sections were mapped and the numbers of spawning adults and redds recorded. Stream sections with substantial areas of suitable spawning gravel were selected as index areas. We surveyed several index areas every 3 to 4 days to monitor the incidence of newly constructed redds. Based on their estimated length, we classified fish as either one- or two-ocean.Spawners were sexed based on appearance and their observed behavior on redds.

Fry Emergence Studies

We applied a technique developed by Phillips and Koski (1969) to estimate survival of steelhead from egg deposition to fry emergence and to monitor timing of emergence. Each year during June, five steelhead redds on the Poverty Flat spawning area were marked at their upstream edge with metal stakes. We selected redds that were feasible to trap and excluded those suspected of exhibiting superimposition. Eggs were deposited by female steelhead of unknown length. We estimated total egg deposition by applying average length of female data collected during our spawner surveys to fecundity data for similar sized fish collected at the Pahsimeroi and Dworshak National fish hatcheries.

Emergence traps were identical to those used by Johnson et al. (1978). The traps measured 3.05 m by 2.44 m and were placed over each redd on July 10, 1984 and July 3, 1985. Emergent fry were counted daily and released. Survival to emergence was calculated by dividing the number of emergent fry by the estimated egg deposition.

Rearing Densities of Fish

We used snorkeling counts of fish in established transects to assess rearing populations of resident and anadromous fish. Counts were made on cloudless days between 0930 and 1630 when visibility was maximum. Several researchers (Goldstein 1978, Griffith 1980, Schill and Griffith 1985, Thurow 1985) have concluded that reliable estimates of fish abundance can be obtained for most salmonids by underwater counts. We conducted our counts in July and August when Juvenile steelhead maintain specific daytime stations and home ranges (Edmundson et al. 1968). Underwater census techniques were ideal for surveying the streams in the SFSR drainage. Experienced divers performed all fish counts. Everest (1969) quantitatively described habitat selected by Juvenile steelhead. We reviewed his descriptions and selected transects exhibiting abundant rubble-boulder substrates, moderate or faster velocities and run-slick qualities. Pools and shallow runs were periodically selected as transects.

Juvenile steelhead were classified by length at age-I (70-130 mm), age-II (130-200 mm) and age-Ill (>200 mm) using a classification system similar to Everest (1969). We did not attempt to count young-of-the-year salmonids (<70 mm) because they were indistinguishable by species and timing of complete emergence was unknown. It is likely that most rainbow trout larger than 250 mm were residualized steelhead or resident rainbow trout (Thurow 1985). I assumed that, below migration barriers, all rainbow trout or steelhead parr less than 250 mm and larger than 70 mm were Juvenile steelhead trout (parr). Rainbow trout or steelhead parr larger than 250 mm were recorded as non-smolting residualized steelhead or resident rainbow trout. Rainbow trout observed above barriers were classified as resident rainbow trout. A resident rainbow trout population often remains when steelhead are blocked from an area (Simpson and Wallace 1982). Total numbers of other game fish were counted by species. Cutthroat trout (*Salmo clarki lewisi*) were recorded in 100 mm size groups. The presence of mountain whitefish (*Prosopium williamsoni*) and nongame species was noted.

Angling gear was used to capture fish in the SFSR and tributaries. Species, total length, date and location of capture were recorded for all fish caught. A battery powered, DC electrofishing unit was used to sample fish in eight streams.

South Fork and East Fork South Fork Salmon River

Transects were established systematically (approximately 5 km apart) on the SFSR between Rice Creek and the mainstem Salmon River, and on the East Fork of the South Fork between Stibnite and the SFSR. Twenty-three transects covering 2.3 km. and 28 transects covering 2.5 km were snorkled in the mainstem SFSR in 1984 and 1985, respectively. Where possible, we proceeded upstream through the transects and counted fish. If upstream counts were not feasible (due to water depth), the divers floated down each transect and counted fish. When two separate floats were not sufficient to count all areas of the transect, we measured the surface area counted by the formula:

$$\text{Surface area snorkeled} = (2V)(L)(G)$$

where: V = Visibility
L = Total transect length
G = Number of lines snorkeled

Underwater visibility was determined by measuring the distance a diver was able to see a submerged brass object (approximately the length of a steelhead parr). Total length and width of each transect was measured with a tape or range finder. Each transect was photographed and physical description and channel composition recorded.

We used a one-way analysis of variance and Duncan's multiple range test to evaluate parr densities in three types of habitat (runs, pools and pocket water). We also completed replicate counts (same area counted by two divers) in 17 SFSR transects in 1984. The replicate count was performed 15 minutes after the initial count.

Tributaries

We established snorkeling transects in 17 tributaries. Most streams were separated into upper, middle, and lower sections based on elevation and stream gradient. Within each section, we established five transects of similar length at sites we considered good steelhead habitat and one transect in a pool habitat type.

Electrofishing sections were established in eight streams. Using a backpack shocker, we made two passes through each section and captured game fish (Seber and Le Cren 1967). Computer program CAPTURE was used to perform computations to estimate the population size and a 95% confidence interval (White et al. 1982).

Physical dimensions of each transect (total length, depth and width at 10 m intervals) were measured. We photographed each site and recorded substrate, channel characteristics and riparian vegetation.

Age and Growth

Wild cutthroat and bull trout were aged using scale analysis. Fish were captured by angling and electrofishing and scales were also removed from angler-creeled fish. We removed scales posterior to the dorsal fin and above the lateral line. Scales were mounted between microscope slides and read with a microprojector. After recording the total number of annuli, we measured the distances from the center focus to each annuli along the median anterior radius.

A regression line was determined by pairing fish total length and anterior scale radius. A Hewlett Packard 41CV calculator and Stat Pac were used to examine several regression models and calculate the best-fit equation.We used this formula to back-calculate mean lengths at each annulus for each age class.

Creel Census

A stratified angler-count census was used to estimate angler effort and harvest. We conducted angler counts on the SFSR, East Fork of the South Fork and Johnson Creek between June 30 and September 21, 1984 and between May 25 and September 13, 1985. The census was stratified by 14-day intervals and day type (weekday, weekend and holiday). During each interval, we randomly selected three weekdays and two weekend days and included holidays for counts. Two counts were made during each day and count periods were adjusted by daylight hours. Mean anglers per day for each interval $(\bar{Y}_I)$ was calculated as:

$(\bar{Y}_I)$

$$\bar{Y}_I = \frac{1}{N} \sum_{i=1}^{L} (N_i \bar{Y}_i)$$

Where $\bar{Y}_i$= the mean number of anglers per day type 1.
N_i= the number of days per day type i.
N = the total days in the interval (14).

The variance of the mean number of angler days in an Interval was estimated as:

$$S^2(\bar{Y}_I) = \frac{1}{N^2} \sum_{i=1}^{L} \frac{N_i^2 \, S_{y_i}^2}{n_i}$$

when n_i = number of counts made for day type 1. = the S_{y_i} standard deviation for y_1.

The total angler hour!. (T_I) for each interval were estimated as:

$$T_I = \bar{Y}_I \cdot D_I$$

with variance:

$$S^2(T_I) = D_I^2 \cdot S^2(\bar{Y}_I)$$

where DI = the total daylight hours in the interval.

Total effort for the season (T_{st}) was estimated as the sum of the intervals. The calculations listed above were performed by the computer program SUMMARY.

Harvest rates were estimated by interviewing angler parties throughout each interval. Harvest rates were calculated for the entire season by considerinthe entire season as one intervalSeasonal harvest rates

($\bar{C}_I$) were calculated as:

$$\bar{C}_I = \frac{B}{W}$$

with variance:

$$S^2(C_I) = \frac{1}{N_I} \quad \frac{\sum W_I \, (\bar{C}_I - C_I)^2}{\sum W_I - 1}$$

where B = total fish harvested by interviewed anglers.
W = total hours fished by interviewed anglers.
C_1= harvest rate for interview i.
W1= hours fished by anglers in interview i.
N1= total numbers of parties interviewed.

Total catch and harvest (H_{st}) for the season were estimated as:

$$H_{st} = T_{st} \cdot \bar{C}_{st}$$

where $\bar{C}_{st}$ = mean harvest rate for the season with variance:

$$S^2(H_{st}) = T_{st}^2 \; S^2(\bar{C}_{st}) + \bar{C}_{st}^2 \; S^2(T_{st})$$

$$H_{st} \pm 2\sqrt{S^2(H_{st})}$$

Genetic Analysis

Personnel from Oregon State University performed genetic analyses on specimens we collected from the SFSR (Schreck et al. 1985). We collected steelhead parr (100 to 200 mm) from Lick Creek and the Secesh River in September 1984 and from Johnson Creek in September 1985. Specimens were packed in ice and frozen within two hours. Oregon State University personnel isolated 23 enzyme system alleles.

RESULTS

Fisheries Resources

Both anadromous (steelhead) and non-migratory (resident) rainbow trout are indigenous to the SFSR. These stocks may be analogous to the redband trout (*Salmo* sp.) described by Behnke (1979).

The fish fauna of the SFSR is represented by five families (Catostomidae, Cottidae, Cyprinidae, Petromyzontidae, and Salmonidae), 10 genera and 15 indigenous species (Table 1). Non-indigenous species include brook trout (*Salvelinus fontinalis*) and catchable rainbow trout. Hatchery-reared chinook salmon smolts have been planted in the SFSR at Knox Bridge (Hutchinson 1984).

Indigenous steelhead, chinook salmon, westslope cutthroat trout and bull trout (*Salvelinus confluentas*) are listed by the Idaho Department of Fish and Game as species of special concern (IDFG 1985).

Steelhead Life History and Movements

South Fork Salmon River steelhead are summer-run fish (migrating into the Columbia River in summer) which appear to be predominately "B-stock" steelhead. By definition, "B-stock" fish pass Bonneville Dam after August 25 and a majority are large (exceeding 71 cm) after spending two years or more in the ocean.

Most SFSR steelhead are large (84% exceed 71 cm). A sample of 52 adult steelhead captured in the SFSR in 1983 (Reid and Anderson 1984), 1984 and 1985 averaged 87 cm and ranged to 101 cm (Fig. 3).

A portion of the steelhead destined for the SFSR ascend the Salmon River in fall, while the remainder over-winter in the Snake River (Mallet 1970). Wild steelhead are in the vicinity of the mouth of the SFSR by mid-September. Anglers in the area have reported "large numbers" of steelhead staging at the mouth of the SFSR in the fall and spring. Our snorkeling surveys also confirmed the late winter (January and February) staging of steelhead there.

Adult steelhead ascend the SFSR in spring and proceed to spawning streams. Between February 1 and April 20, twenty-two steelhead were caught or observed while staging in sections of the lower 55 km of the SFSR (Table 2). A majority (91%) were observed after March 15. Steelhead were observed 16 km upstream by March 29. Spawning ground surveys indicate that steelhead arrived at Poverty Flat (rkm 90) by April 16.

Table 1. Indigenous fish present in the South Fork Salmon River drainage.

Common name	Scientific name	Status by location	
		South Fork	Tributaries
Rainbow-steelhead trout	Salmo gairdneri	abundant	abundant
Westslope cutthroat trout	Salmo clarki lewisi	currently depressed	currently depressed
Chinook salmon	Oncorhynchus tshawtyscha	currently depressed	currently depressed
Bull trout	Salvelinus confluentus	common	common
Mountain whitefish	Prosopium williamsoni	abundant	common
Northern squawfish	Ptychocheilus oregonensis	common in lower 10km	uncommon
Redside shiner	Richardsonius balteatus	uncommon	uncommon
Bridgelip sucker	Catostomus columbianus	unknown	unknown
Longnose dace	Rhinichthys cataractae	common	common
Speckled dace	Rhinichthys osculus	unknown	unknown
Shorthead sculpin	Cottus confusus	unknown	unknown
Mottled sculpin	Cottus bairdi	unknown	unknown
Torrent sculpin	Cottus rhotheus	unknown	unknown
Pacific lamprey	Entosphenus tridentatus	unknown	unknown

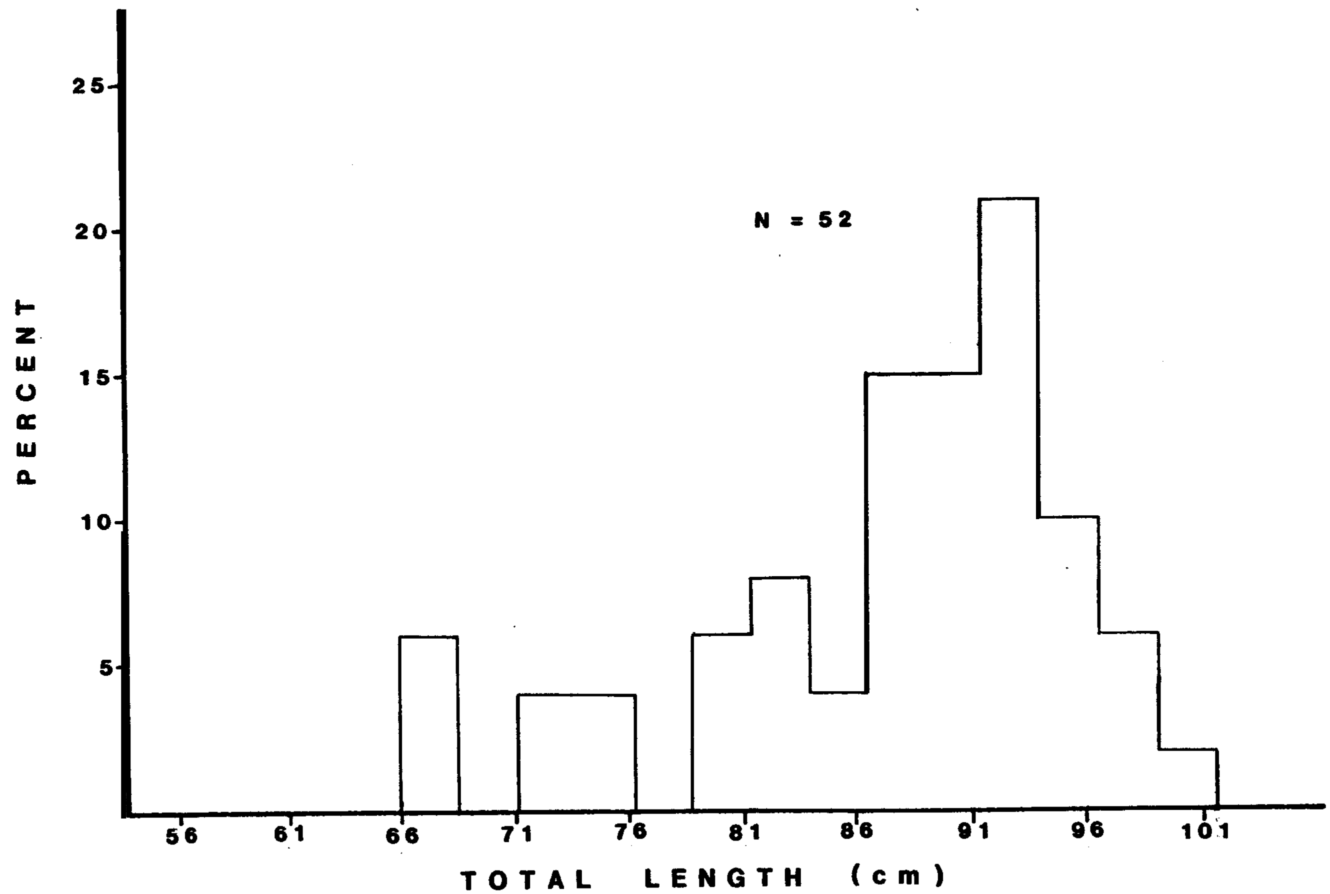

Figure 3. Length frequency of wild steelhead trout caught in the South Fork Salmon River, 1983-1984.

Table 2. Results of spring surveys for adult steelhead in the South Fork Salmon River below its confluence with the East Fork of the South Fork, 1984 and 1985.

Date	Location surveyed	River km surveyed	Number of steelhead caught or observed
1984			
February 1	Mouth of South Fork	0.0 to 0.5	1
February 8	Mouth of South Fork	0.0 to 0.5	1
March 27 to 30	Mouth to South Fork Road	0.0 to 55	4
April 12 to 14	Mouth to Hettinger Ranch	0.0 to 25	6
April 18 to 20	Mouth to Rooster Creek	0.0 to 10	2
1985			
January 16	Mouth of South Fork	0.0 to 0.5	0
February 27	Mouth of South Fork	0.0 to 0.5	0
March 15	Mouth of South Fork	0.0 to 0.5	3
March 20	Mouth to Station Creek	0.0 to 4.7	3
March 28 to 31	Mouth to Chine Creek	0.0 to 27	2

Steelhead Spawning Characteristics

In 1984, we observed 407 redds and 292 adult steelhead during surveys which probably accounted for 60% of the potential spawning (Tables 3 and 4). In 1985, we observed 536 redds and 658 adults which probably accounted for 70% of the potential spawning. If each female constructed an average of 1.4 redds (Johnson et al. 1978) and sex ratios averaged 1.5 females per male (Thurow 1985), a conservative estimate of 800 and 900 steelhead spawned in the SFSR during 1984 and 1985, respectively.

Similar numbers of steelhead spawned in the SFSR and tributaries in 1984 and 1985. We observed 404 redds in 1984 and 432 redds in 1985 within identical index areas during similar days of observation (April 16 to May 11, 1984 and April 22 to May 9, 1985). The number of redds observed on index areas did not differ significantly between 1984 and 1985 (Two-way ANOVA, $p > .05$). Although we observed 21% more redds on mainstem index areas in 1985 as compared to 1984, 26% fewer redds were observed in tributary index areas.

In contrast to past reports that 80% of the spawning occurred in tributaries (Anonymous 1977), we found 70% to 80% of the spawning occurred in mainstem areas. A majority of the spawning may have also occurred on mainstem areas in the past. As Richards (1961b) observed, the SFSR steelhead fishery took place to a large degree on shallow mainstem spawning areas. Anglers harvested nearly 600 steelhead from those spawning areas in April and May of 1961.

Certain tributaries do support significant spawning populations. Between 1962 and 1964, Finn (1966) observed from 60 to 80 steelhead spawning in lower Lick Creek. In 1984 and 1985 we observed 34 and 25 redds, respectively, in the same reach.

The variable fluctuations in spawner escapements we observed between 1984 and 1985 suggest that discrete spawning populations exist in individual mainstem areas and tributaries. We also observed subtle differences in timing of initial, maximum, and final spawning between index areas.

South Fork Salmon River

Steelhead spawned throughout the mainstem SFSR in 1984 and 1985. Most of the spawning occurred between the confluence of the East Fork of the South Fork with the SFSR and the Warm Lake Road (Table 3). Principal spawning areas were located near Stolle Meadows, from Knox Bridge to Penny Spring, Poverty Flat, Darling cabins, the Oxbow, and from 22 Hole to Glory Hole. Index areas were selected at each of these sites (Figs. 4 and 5).

Spawners and redds were also observed below the confluence of the East Fork of the South Fork and SFSR. On May 7, 1984 three redds and one spawner were observed near Chicken Creek, and on May 12, 1985, one redd and one spawner were observed in the same location. In 1983, biologists observed a steelhead constructing a redd near Knob Creek (D. Burns,

Table 3. Observations of steelhead trout spawners and redds on the South Fork Salmon River mainstem, April-May 1984 and 1985.

Location	No. steelhead	Sexed steelhead male	Sexed steelhead female	No. redds	Index area length surveyed (km)	Index area redds per km
Mainstem SFSR 1984						
Stolle (Warm Lake road to Rice Creek)	0	0	0	6	13.0	2.2
Poverty (Boulder run to Campground Bridge)	106	54	36	125	1.5	83.3
Oxbow (Breach to main road)	50	24	13	61	2.5	24.4
Darling (Cabins to Binwall)	18	5	2	44	1.3	33.9
Glory Hole to 22 Hole	65	26	23	47	--	--
Below East Fork South Fork	1	0	0	3	--	--
Total	240	109	74	286	18.3	$\bar{x}$ =12.9
Mainstem SFSR 1985						
Stolle (Warm Lake road to Rice Creek) [a]	0	0	0	7	13.0	0.5
Knox Bridge to Cabin Creek	7	1	5	12	--	--
Cabin Creek to Six Bit Creek	17	6	10	19	--	--
Six Bit Creek.to Nickle Creek	12	2	4	13	--	--
Poverty (Boulder run to Campground Bridge)	126	46	36	93	1.5	62.0
Darling (Cabins to Binwall)	71	14	21	56	1.3	43.1
Oxbow (Breach to main road)	166	51	44	109	2.5	43.6
22 Hole to Salmon Camp	69	31	27	37	--	--
Salmon Camp to Krassel Bridge	42	14	16	26	--	--
Krassel Bridge to Glory Hole	59	17	19	61		
Below East Fork South Fork [a]	1	0	0	1	--	--
Total	570	182	182	434	18.3	$\bar{x}$ =14.5

[a] Aerial survey

R9R8384JP

Table 4. Observations of steelhead trout spawners and redds on South Fork Salmon River tributaries, April-May 1984 and 1985.

Location	No. steelhead	Sexed steelhead male	Sexed steelhead female	No. redds	Index area length surveyed (km)	Index area redds per km
Tributaries 1984						
Buckhorn	2	0	0	0		
Burntlog (Mouth to 1st Tributary above Buck Creek)	3	1	1	9	2.3	3.9
Camp (Mouth to SFSR Road)	2	1	1	3	--	--
East Fork (Mouth to Park's Creek)	10	4	5	16	21.0	0.8
(Above Vibika Creek)	0	0	0	0	--	--
Fitsum (Mouth to Barrier)	0	0	0	0	--	--
Fourmile (Mouth to SFSR Road)	0	0	0	1	--	--
Johnson (Top Deadhorse Rapids to Clements Bridge)	27	10	9	47	4.8	9.8
Lick (Mouth to 1st falls)	8	2	4	34	4.5	7.6
Secesh (Chinook Campground to Grouse Creek) [a]	0	0	0	11	10.0	1.1
Total	52	18	20	1 21	42.6	$\bar{x}$ =2.8
Tributaries 1985						
Buckhorn	2	0	0	0	--	--
Burnt Log	2	0	1	7	2.3	3.0
Camp	1	0	1	4	--	--
East Fork South Fork						
(Williams Cr. to Parks Cr.)	19	8	11	17	21.0	0.8
(Vibika Cr to Tamarack Cr.)	11	3	6	9	--	--
Fitsum	7	1	4	6	--	--
Johnson	34	10	11	26	4.8	5.4
Lick	12	1	7	25	4.5	5.6
Secesh [a]	0	0	0	5	10.0	0.5
Tamarack Cr.	0	0	0	3	2.0	1.5
Total	88	23	41	102	44.6	$\bar{x}$ =1.9

[a] Aerial survey

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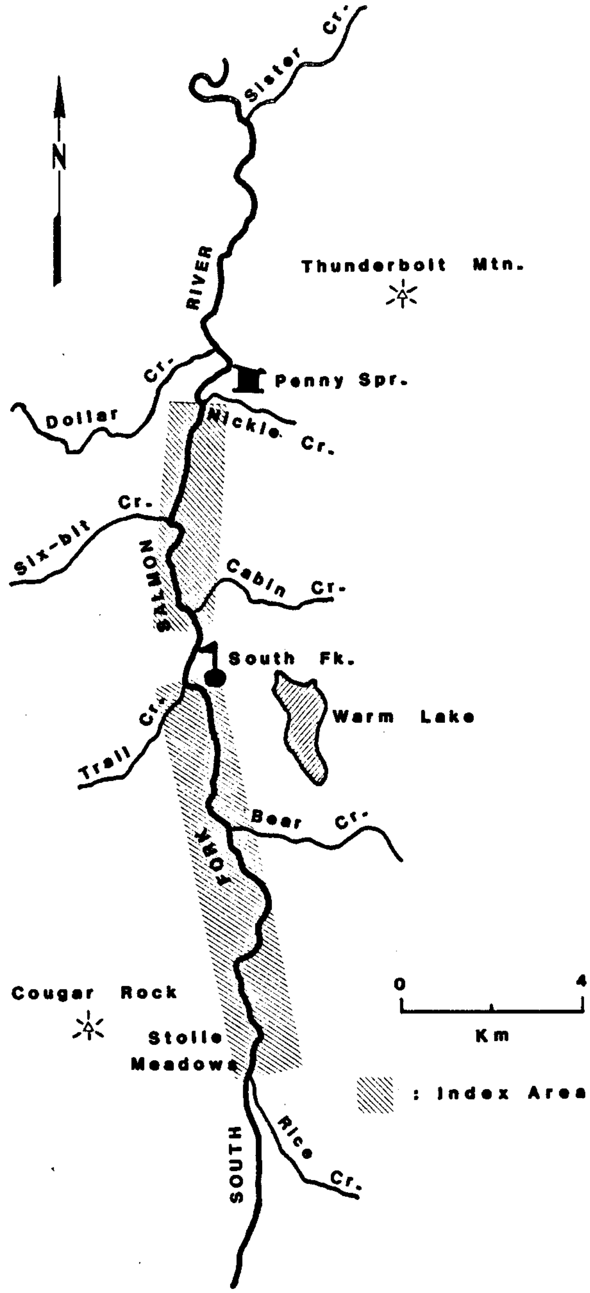

Figure 4. Spawning ground index area map of Stolle Meadows and Knox Bridge to Penny Spring, South Fork Salmon River, Idaho.

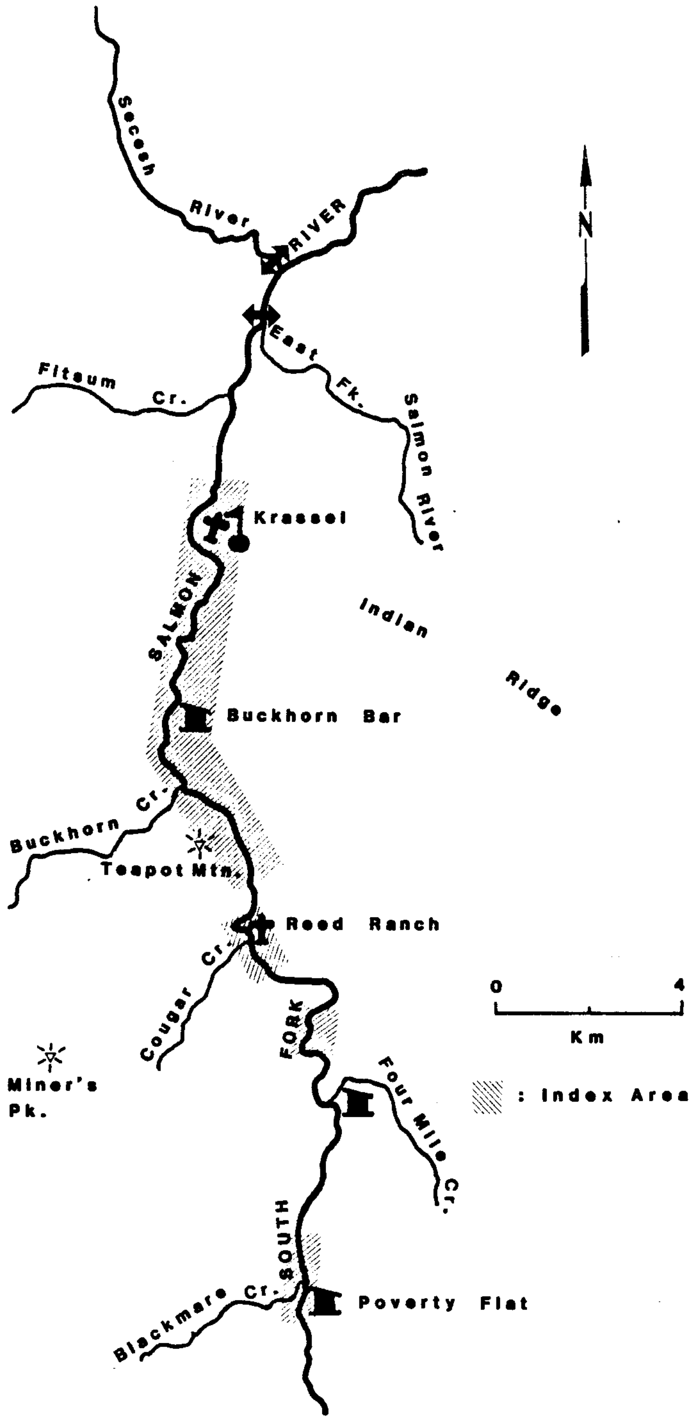

Figure 5. Spawning ground index area map of Poverty Flat, Darling Cabins, the Oxbow, and 22 Hole to Glory Hole, South Fork Salmon River, Idaho.

Payette National Forest, personal communication). Several sites with suitable spawning substrate occur in lower sections of the SFSR (Fig. 6).

Redd counts were compared between 1984 and 1985 for identical index areas during similar survey dates. Redd counts increased in two areas, decreased in one area and remained similar in the remainder (Table 3). Overall redd counts did not differ significantly between 1984 and 1985 (Two-way ANOVA, $p > .05$).

Sex ratios of steelhead spawners averaged 1.5 males per female in 1984 and one male per female in 1985 (Table 3). The proportion of males generally increased as the spawning period progressed. Males remained on spawning areas longer than females and individual males were observed spawning with several different females. Female steelhead generally remained on redds for three days or less.

The proportion of two- and three-ocean spawners increased significantly from 1984 (79%) to 1985 (87%) (Chi-square, $p < .05$) (Table 3).

Redd densities on index areas ranged from 2.2 to 83.3 per km and averaged 12.9 per km in 1984 and 14.5 per km in 1985 (Table 3). The largest density of redds occurred on the Poverty reach where we observed 32% of the total redds counted in the mainstem SFSR in 1984 and 1985. We surveyed the Poverty reach every 3 to 4 days between April 24 and May 11, 1984, and observed an average of 20 new redds on each survey (Fig. 7). Intense spawning activity occurred over a 3 to 4 week period with no definite peak. A similar increase in redds over time was observed on four index areas in 1985 although the timing of spawning varied between areas (Fig. 8). Although complete counts were not feasible after May 11, 1984 and May 16, 1985 due to turbid water conditions, we observed fish still constructing redds on May 28, 1984 and June 1, 1985.

Tributaries

Steelhead began spawning in tributaries one to two weeks later than in mainstem areas, possibly due to colder water temperatures. Initial redds were observed in tributaries on May 3, 1984 and May 8, 1985 compared to initial redds observed on mainstem areas on April 16, 1984 and April 22, 1985. Fourteen tributaries were surveyed in 1984 and 1985 and we observed adult steelhead and redds in ten streams (Table 4). Principal spawning areas are located in sections of Burntlog, Johnson and Lick creeks; and the East Fork of the South Fork and Secesh rivers. Index areas were selected in each of these reaches (Figs. 9 to 11). It is likely that additional tributaries support spawning steelhead; however, water conditions were subject to change and only a portion of the spawners and redds in a stream reach were visible.

Redd counts were compared between 1984 and 1985 for identical tributary index areas during similar survey dates. Counts decreased in three areas and remained similar in the remainder (Table 4). Overall redd counts did not differ significantly between 1984 and 1985 (Two-way ANOVA, $p > .05$).

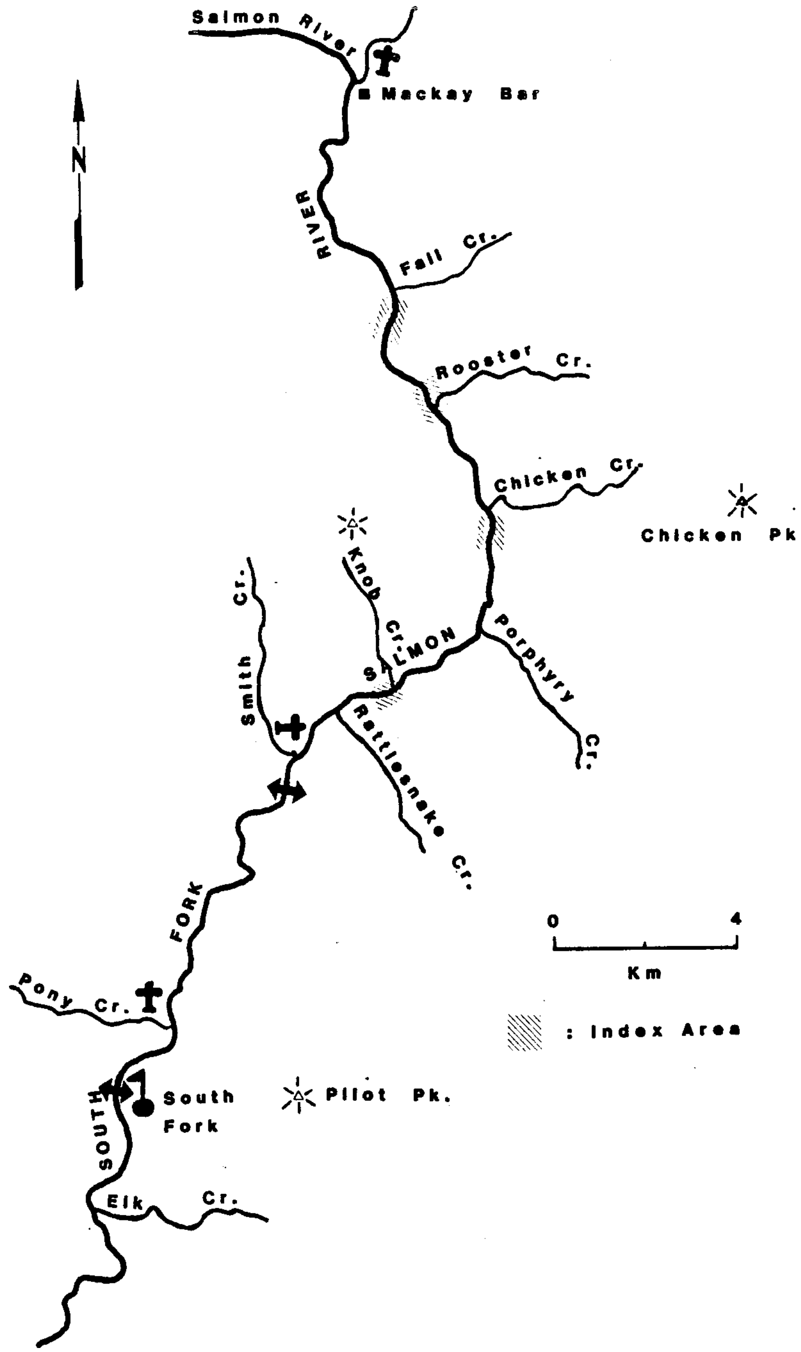

Figure 6. Suitable spawning areas observed on the South Fork Salmon River, Idaho below its confluence with the East Fork South Fork, 1984.

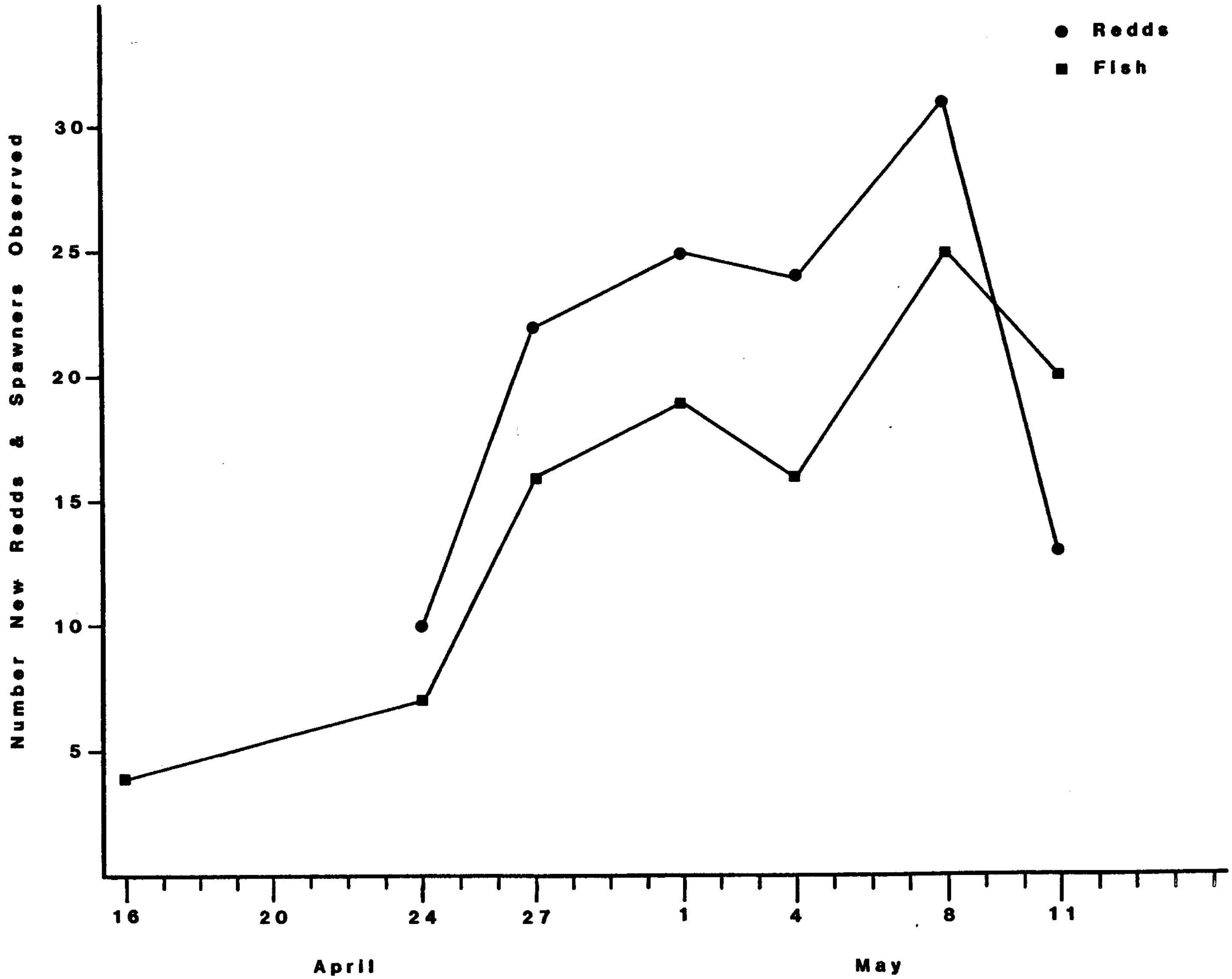

Figure 7. Steelhead trout redds and spawners observed on the Poverty Flat spawning area, South Fork Salmon River, 1984.

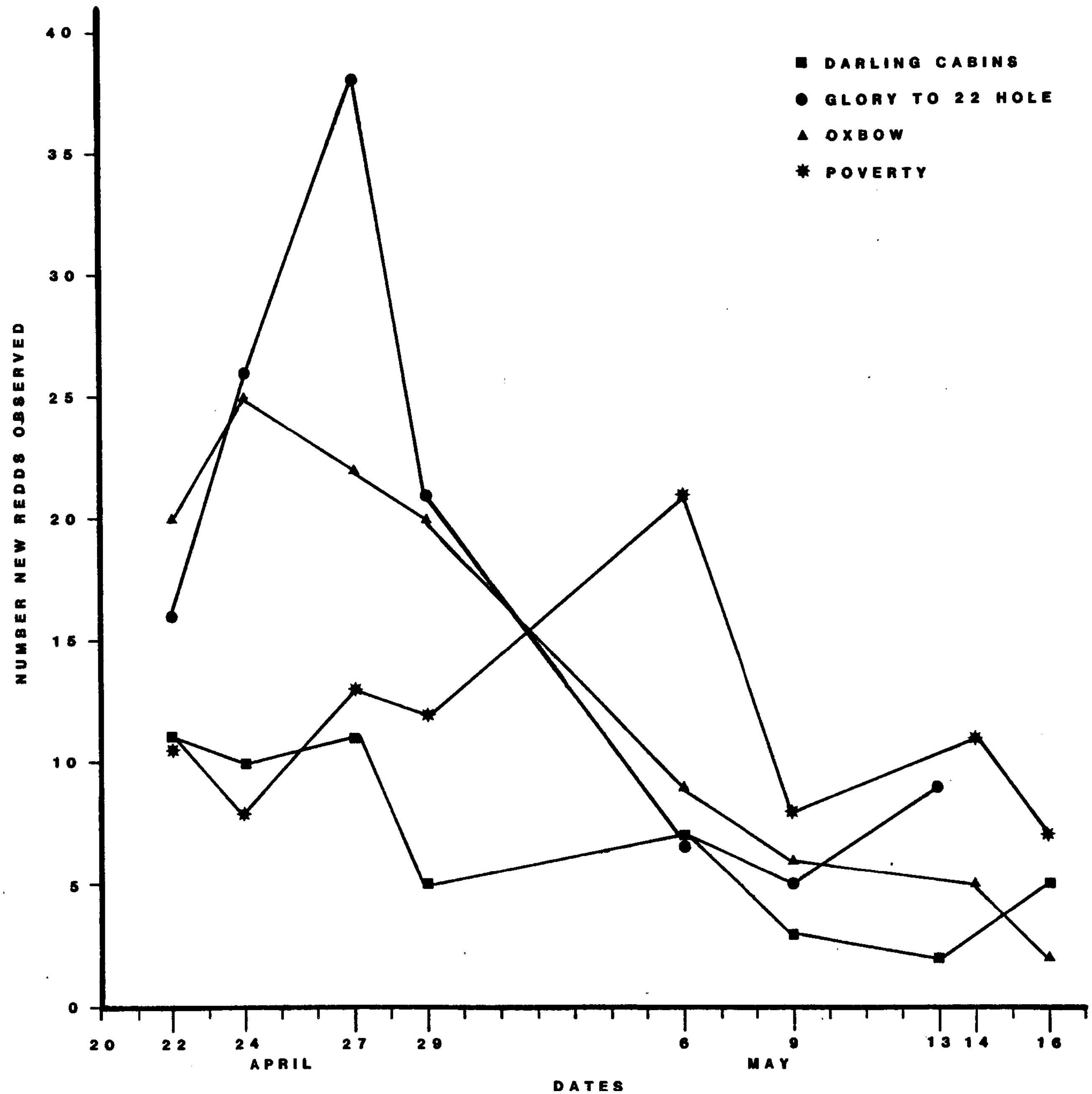

Figure 8. Steelhead trout redds observed over time on four South Fork Salmon River index areas, 1985.

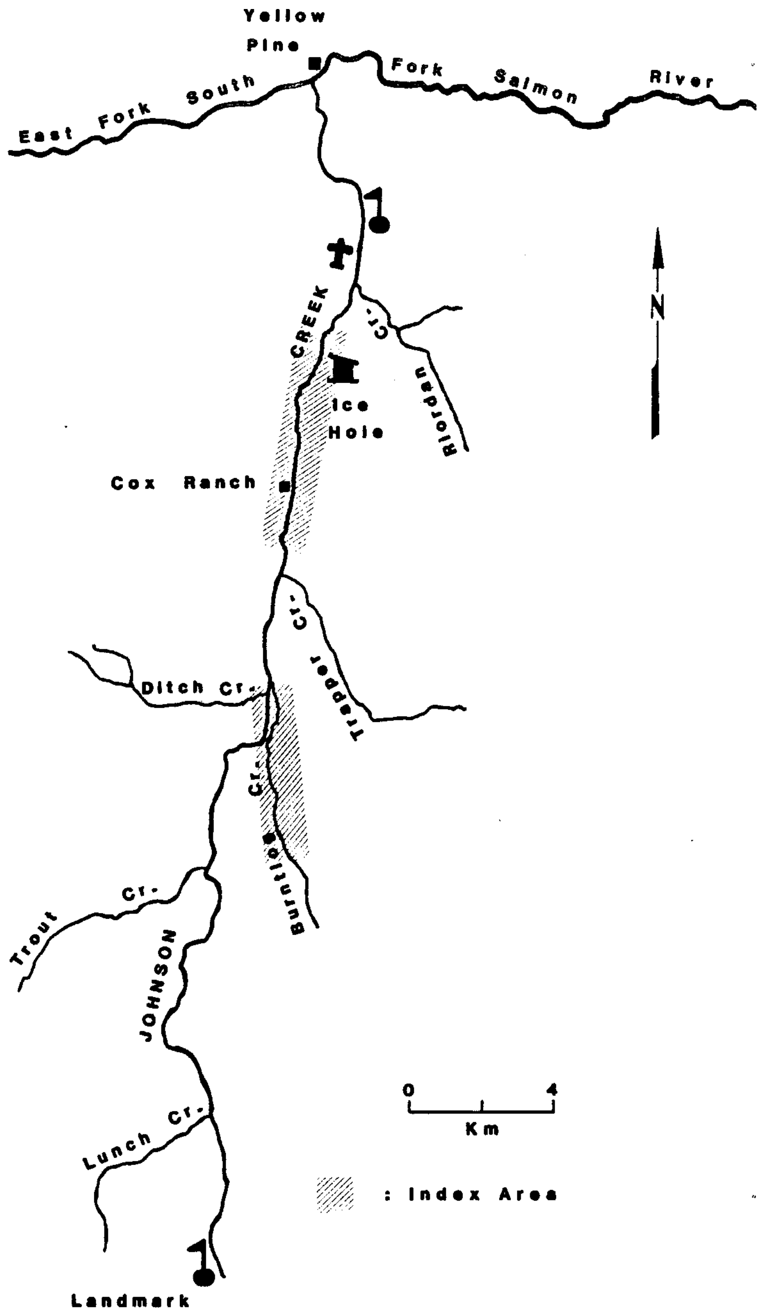

Figure 9. Spawning ground index area map of Johnson and Burntlog creeks, South Fork Salmon River, Idaho.

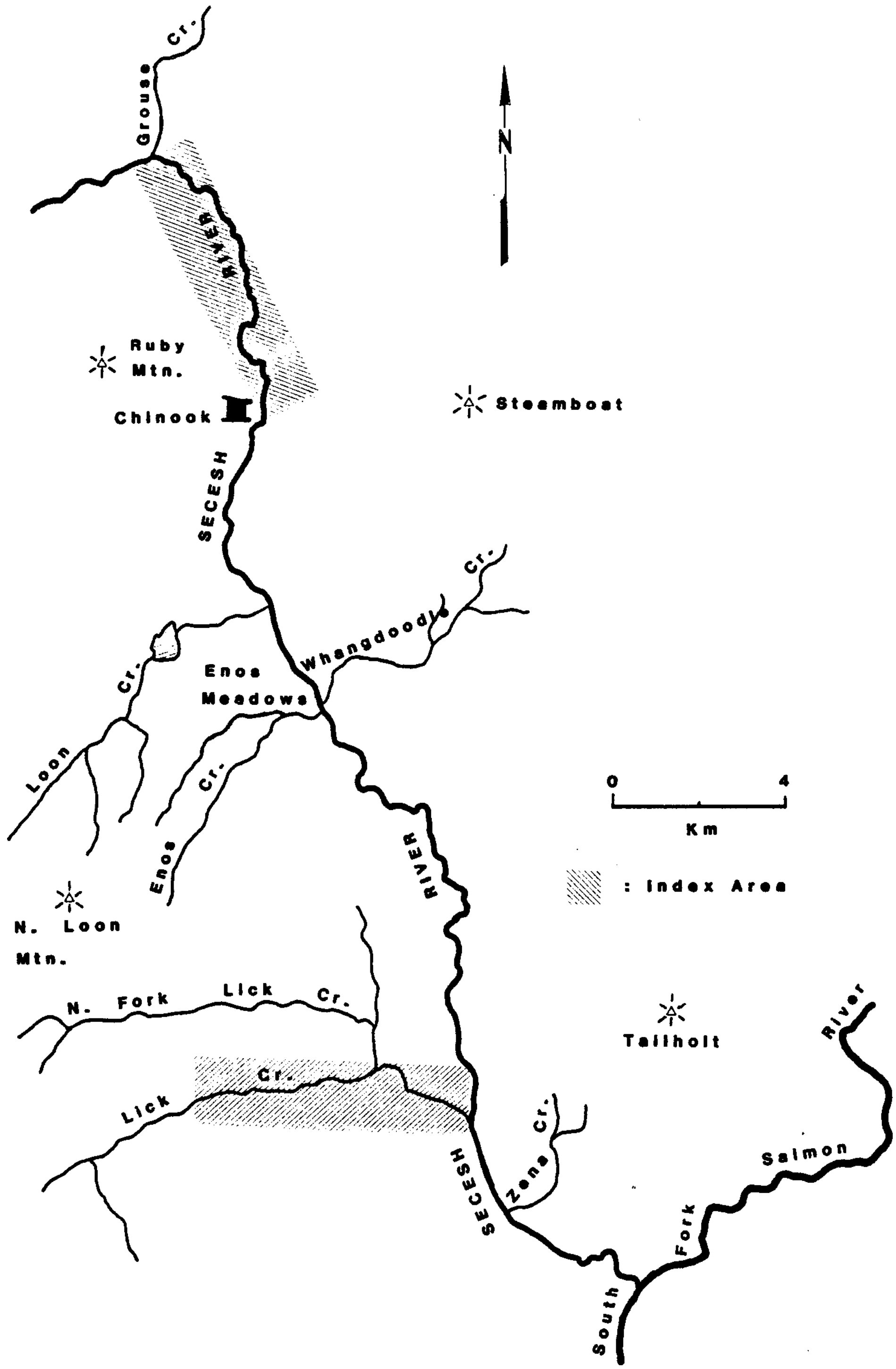

Figure 10. Spawning ground index area map of Lick Creek and the Secesh River, South Fork Salmon River, Idaho.

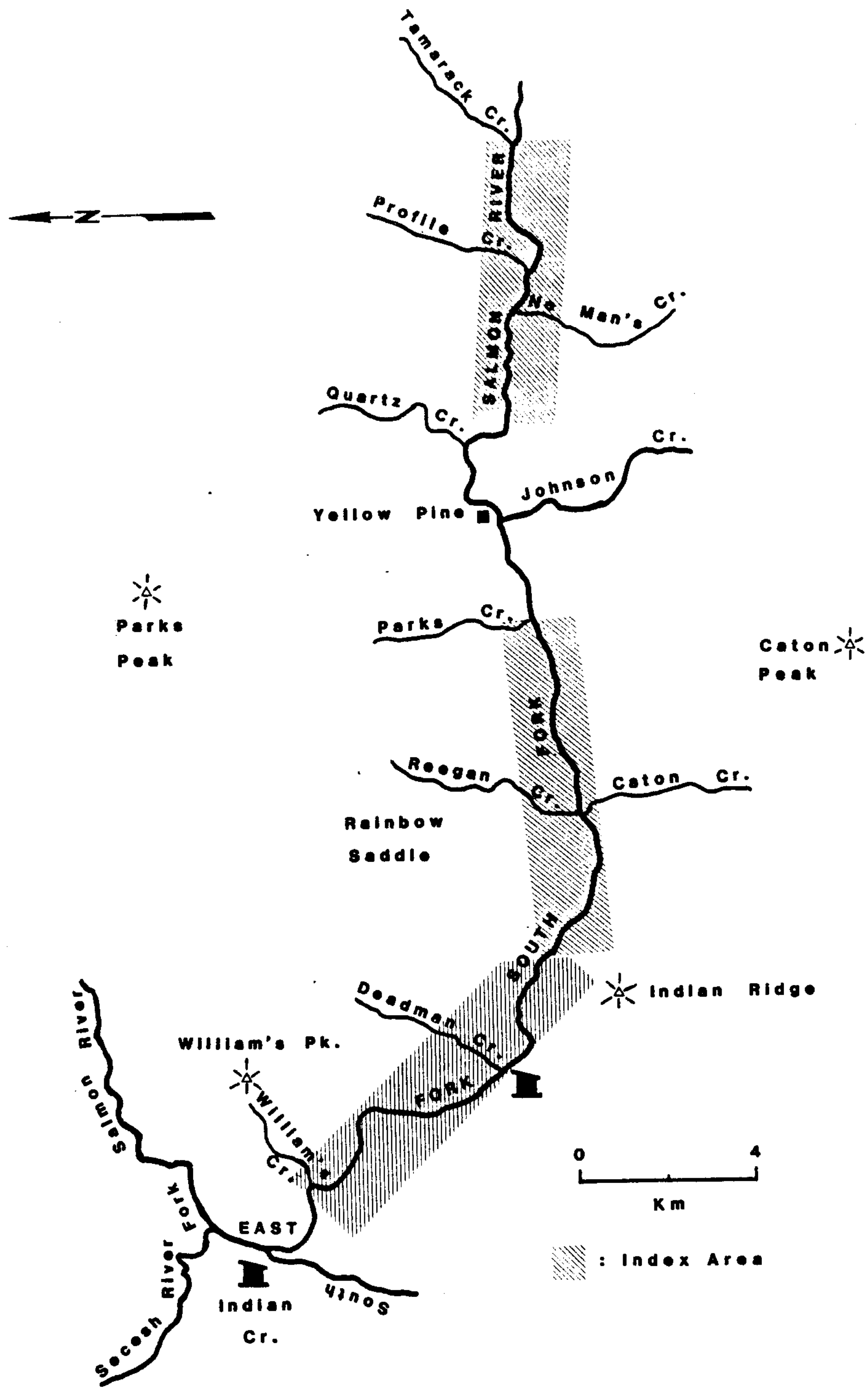

Figure 11. Spawning ground index area map of the the East Fork South Fork, South Fork Salmon River, Idaho.

Sex ratios of steelhead spawners averaged 1.1 females per male in 1984 and 1.8 females per male in 1985 (Table 4). The proportion of two- and three-ocean spawners increased significantly in tributaries from 1984 to 1985 (Chi-square, $p < .05$) (Table 4). The proportion of two- and three-ocean spawners did not differ significantly between tributaries and mainstem index areas within the same year (Chi-square, $p > .05$).

Redd densities on index areas ranged from 0.8 to 9.8 per km and averaged 2.8 per km in 1984 and 1.9 per km in 1985 (Table 4). The largest densities of redds occurred in the Johnson and Lick creek reaches where we observed 59% of the total redds in tributaries in 1984 and 1985.

Steelhead Fry Emergence

Steelhead fry emerged from each redd trapped in 1984 and 1985 (Figs. 12 and 13). Lower stream discharge and warmer water temperatures (maximum temperatures averaged 18.2C in 1985 as compared to 16.7C in 1984) accelerated emergence in 1985 as compared to 1984. In 1985, emergence commenced on July 3 and 98% of the fry had emerged by July 17. In contrast, in 1984 emergence commenced on July 14 and 98% of the fry had emerged by August 10. Although several redds were dewatered by low stream discharge in August 1985, emergence was complete prior to dewatering. Emergence was nearly completed in nine of ten redds within two weeks. The exception (redd No. 4 in 1984) displayed a bimodal distribution of emerging fry (suggesting a multiple redd) from which fry emerged for 42 days. Fry continued emerging until August 25 in 1984 and August 20, 1985. Johnson et al. (1978) also reported 95% emergence of steelhead fry within 14 days for redds trapped in Snow Creek, Washington.

Most fry apparently emerged after dark. We checked the traps twice daily over a 20 day period in 1984 and 87% of the fry were captured between the late afternoon and early morning period.

Unfortunately, fecundity data for Idaho wild steelhead are available for only two locations: 1) A-stock steelhead trapped at Oxbow dam from 1966 to 1968 (Garrett 1966-1968) which averaged 3,200 eggs per female and 2) B-stock steelhead trapped in the North Fork Clearwater River from 1969 to 1971 (records of Dworshak National Fish Hatchery) which averaged 6,000 eggs per female. Several years of fecundity data are available for hatchery steelhead spawned at the Pahsimeroi Hatchery (Moore 1981-1985) and Dworshak National Fish Hatchery (D. Diggs, USFWS Fisheries Assistance Office, personal communication). B-stock hatchery steelhead averaged 6,700 eggs per female at Pahsimeroi from 1981 to 1985 and 6,600 eggs per female at Dworshak from 1979 to 1985. A-stock hatchery steelhead averaged 4,600 eggs per female at Pahsimeroi since 1975. Hatchery steelhead exhibit higher fecundities than wild stocks due to 1) past selection for largest fish when spawning, 2) a shift in larger proportions of two-ocean fish at the Pahsimeroi Hatchery, and 3) inclusion of one-ocean, B-stock with A-stock fecundity calculations at the Pahsimeroi Hatchery.

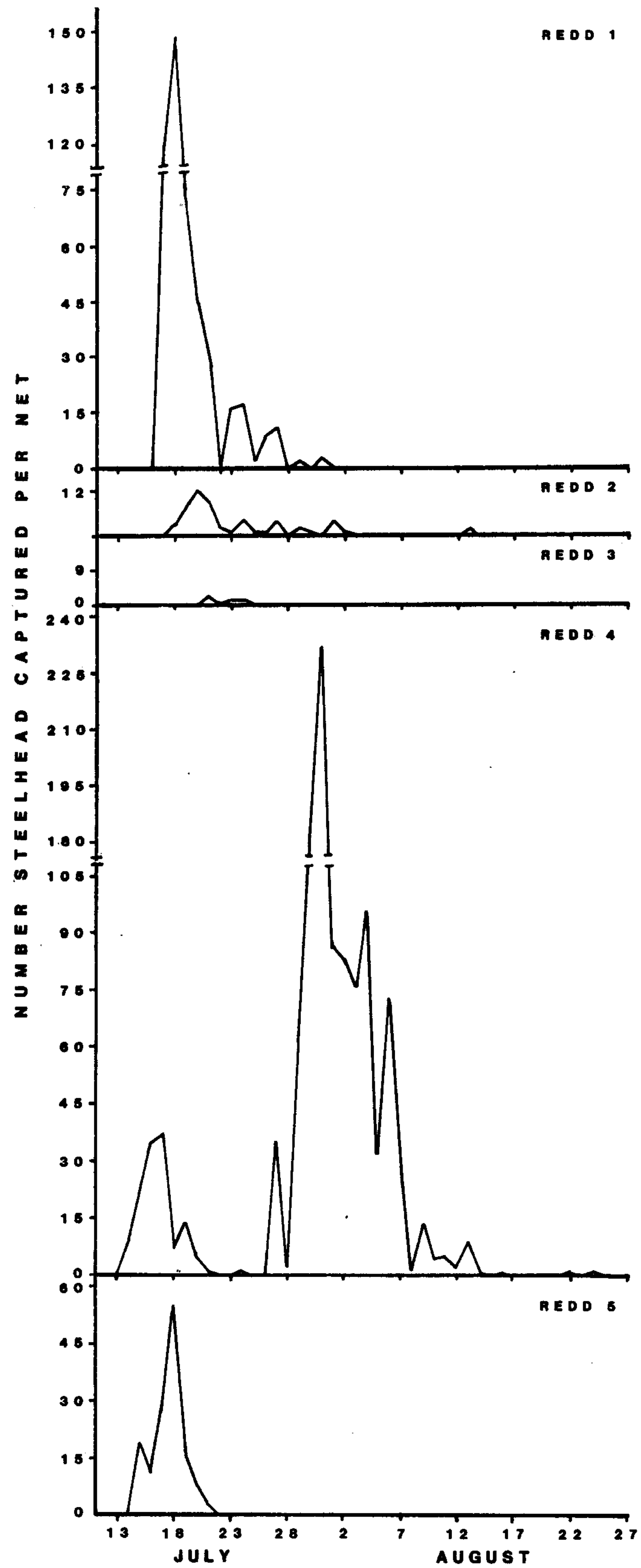

Figure 12. Numbers of steelhead trout fry emerging over time in five trapped redds on the Poverty Flat spawning area, July-August 1984.

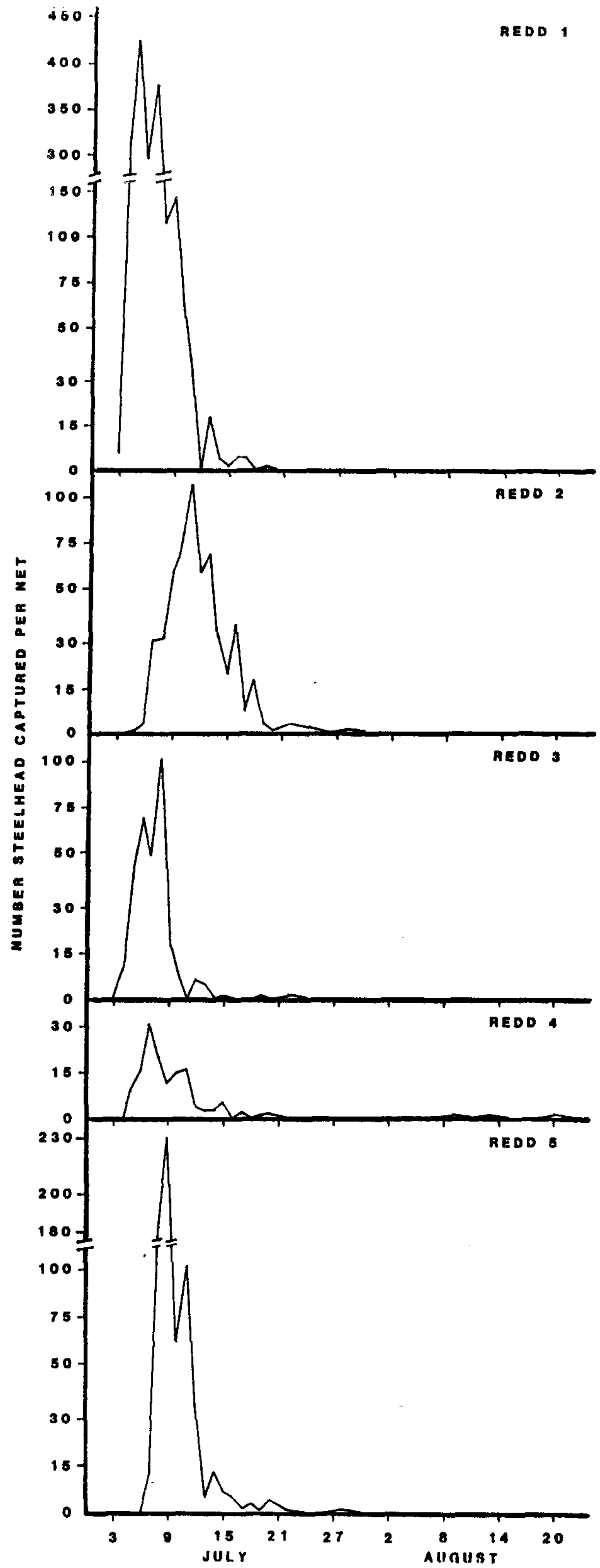

Figure 13. Numbers of steelhead trout fry emerging over time in five trapped redds on the Poverty Flat spawning area, July-August 1985.

Potential egg deposition was estimated to be 5,500 and 5,700 eggs per female for the Poverty Flat spawning area in 1984 and 1985, respectively. I estimated that an average two- or three-ocean female contained 6,000 eggs and a one-ocean female contained 4,500 eggs. An average of 72% and 81% of the females on Poverty Flat were two- or three-ocean fish in 1984 and 1985, respectively. Applying these ratios, the average female contained 5,500 eggs in 1984 and 5,700 eggs in 1985. We assummed that retention of eggs was minimal (T. Johnson, Washington Department of Game, personal communication).

The principal cause for inaccuracy of fry emergence data is the difficulty of predicting egg deposition. Egg deposition prediction may be inaccurate because 1) actual fish length versus fecundity data are unavailable for the SFSR wild stock, 2) female steelhead may construct multiple redds, and 3) superimposition of redds may occur. Johnson et al. (1978) observed nearly 40% of the female steelhead in Snow Creek constructing partial redds. Trapping of partial redds would underestimate actual egg to fry survival and trapping of superimposed redds would overestimate fry survival. In calculating egg-to-fry survival, I assumed that all redds with emergence of less than 100 fry in 14 days were partial redds (redds No. 2 and 3 in 1984). I further assumed that redd No. 4 in 1984 and redd No. 1 in 1985 were superimposed. Fry emerged from redd No. 4 in 1984 over a 42 day period in a bimodal distribution. Nearly five times as many fry emerged from redd No. 1 in 1985 as from any other trapped redd except redd No. 4 in 1984. The remaining six redds were assumed to be complete, individual redds.

Egg-to-fry survival on the Poverty Flat spawning area averaged 8% in 1984 and 10% in 1985 for an overall average of 9%. Survival in individual redds ranged from 3 to 10.5% In 1984 and from 3 to 16% in 1985. These values closely approximate the predicted egg-to-fry survival for the existing percent fine sediment (30 to 35%) (USDA-Forest Service 1985) on Poverty Flat (Stowell et al. 1983).

Fish Distribution and Abundance

South Fork Salmon River

Steelhead parr comprised a majority of the age-I and older salmonids in the SFSR in 1984 (92%) and 1985 (94%) (Table 5). Steelhead parr were present in 21 transects each year and were most abundant in transects 19 through 27 (Badley Ranch to Sheep Creek, rkm 4 through 51).

Transects ranged from 50 to 150 m long (Appendix B). Visibility improved as we proceeded downriver and ranged from 5 to 7 m in 1984 and from 4.9 to 7.7 m in 1985. Gravel was the predominate substrate in transects 1 through 6, and boulders and rubble were the predominate substrates in transects below Dime Creek (No. 7). Water temperatures varied from 10.5 to 18.5 C in 1984 and from 8.5 to 17 C in 1985.

Densities of steelhead parr were similar in 1984 and 1985 in identical transects (Table 5). Densities of age-I, II and Ill and total steelhead parr (fish per 100 m^2) were not significantly different between 1984 and
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Table 5. Numbers and densities of staslhead parr observed in South Fork Salmon River transacts, July-August, 1984 end 1985.

		1984								1985							
	Habitat	Number etaelhead parr				Density (No. per 1008^2)				Number of etaelhead parr				Density (No. per 100m^2)			
Transact	type[a]	Age I	Age II	Age III	Total	Age I	Age II	Age III	Total	Age I	Age II	Age III	Total	Age I	Age II	Age III	Total
1	I	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
2	II	0	1	0	1	0.00	0.24	0.00	0.24	0	0	0	0	0.00	0.00	0.00	0.00
3	I	3	2	1	6	0.84	0.43	0.21	1.28	4	2	0	8	0.94	0.47	0.00	1.41
4	I	1	1	0	2	0.19	0.19	0.00	0.38	0	0	0	0	0.00	0.00	0.00	0.00
5	I	5	2	0	7	1.02	0.41	0.00	1.43	3	1	0	4	0.63	0.21	0.00	0.84
6	I	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
7	II	12	8	3	23	1.84	1.23	0.48	3.53	0	5	2	7	0.00	0.87	0.35	1.22
8	I	--	-	-	-	-	-	-	-	0	0	0	0	0.00	0.00	0.00	0.00
9	II					-		-	-	0	0	2	2	0.00	0.00	0.20	0.20
10	I	-	-	-	-	-	-	-	-	0	0	0	0	0.00	0.00	0.00	0.00
11	II	11	15	2	28	1.05	1.44	0.18	2.88	12	17	1	30	1.09	1.56	0.10	2.75
12	II	16	6	2	24	0.86	0.32	0.10	1.28	4	2	0	8	0.23	0.12	0.00	0.35
13	III	1	2	0	3	0.04	0.08	0.00	0.12	0	0	0	0	0.00	0.00	0.00	0.00
14	III	8	8	0	18	0.48	0.48	0.00	0.92	1	0	1	2	0.05	0.00	0.05	0.10
15	II	10	5	0	15	0.37	0.18	0.00	0.65	0	0	2	2	0.00	0.00	0.17	0.17
16	II	12	9	0	21	0.52	0.39	0.00	0.91	2	5	1	8	0.08	0.19	0.03	0.30
17	I	0	1	0	1	0.00	0.05	0.00	0.05	1	0	1	2	0.04	0.00	0.04	0.08
18	III	0	1	1	2	0.00	0.03	0.03	0.06	0	0	1	1	0.00	0.00	0.04	0.04
19	II	35	32	7	74	0.97	0.88	0.19	2.04	21	39	10	70	0.70	1.32	0.33	2.35
20	III	9	16	4	29	0.28	0.47	0.11	0.84	31	50	7	88	0.85	1.52	0.22	2.89
21	II	29	36	4	69	0.94	1.18	0.12	2.22	19	30	4	63	0.58	0.94	0.13	1.65
22	III	3	14	2	19	0.14	0.68	0.09	0.89	1	3	0	4	0.05	0.13	0.00	0.18
23	II	7	24	2	33	0.24	0.85	0.07	1.16	6	28	3	35	0.20	0.85	0.10	1.15
24	III	1	1	0	2	0.03	0.03	0.00	0:08	2	4	1	7	0.06	0.11	0.03	0.20
25	II	17	35	7	59	0.61	1.27	0.25	2.13	44	69	8	122	1.42	2.21	0.28	3.92
26	III	17	24	2	43	0.52	0.74	0.06	1.32	20	61	8	79	0.67	1.89	0.28	2.82
27	II	7	20	1	28	0.25	0.71	0.03	0.99	11	69	8	78	0.45	2.42	0.37	3.24
28	III	4	4	1	8	0.15	0.15	0.03	0.33	4	8	5	17	0.15	0.30	0.18	0.64
Totals		208	267	39	514	1=0.42	14.53	1=0.08	1=1.03	186	371	87	624	7=0.38	1=0.72	1=0.13	1=1.22

[a]I = Run Run II = Pocket Water III = Pool

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1985 ($p > .05$). Densities of age-I and older steelhead parr ranged from 0 to 3.92 per 100 m^2 and averaged 1.03 and 1.22 per 100 m^2 in 1984 and 1985, respectively. Age-I and older parr densities were significantly larger in pocket water habitats ($p < .05$) than in run and pool habitats. Densities of age-I and older parr in run and pool habitats were not significantly different ($p > .05$). Age-I steelhead were most abundant in pocket water and runs, age-II steelhead were most abundant in pocket water, and age-III steelhead utilized all three habitat types at similar densities.

There were no significant differences in the numbers of steelhead parr observed by divers No. 1 and No. 2 ($p > .05$, paired Student t test). This suggests that steelhead parr did not significantly migrate into or out of the transects between the replicate counts.

Angling was effective for collecting species composition and length-frequency data. We captured 459 game fish during 12 days of angling surveys (Table 6). Steelhead parr comprised 95% of the fish captured and most (81%) were less than 200 mm (Fig. 14). Length frequencies of hook-and-line caught steelhead parr were nearly identical in 1984 and 1985. Lengths of steelhead parr were similar in lower and middle sections of the SFSR. Hook-and-line gear was ineffective in sampling steelhead less than 130 mm (age I). The age-frequency of steelhead parr observed by snorkeling equaled 40% age-I, 52% age-II and 8% age-II in 1984 and 30% age-I, 59% age-II and 11% age-Ill in 1985 (Table 5).

Chinook salmon (chinook) were observed in 22 of 25 transects in 1984 and 23 of 28 transects in 1985 (Table 7). In 1984 we observed 1,082 age-0 chinook which averaged 2.2 per 100 m^2 of stream and in 1985 we observed 981 age-0 chinook which averaged 1.9 per 100 m^2 of stream. Densities were not significantly different between 1984 and 1985 ($p > .05$). Age-0 chinook were least abundant in the lower 27 km of the SFSR (Transects 23 to 28) and in the area above Rice Creek (km 130). We observed 20 age-I chinook which comprised 2% of the game fish observed in 1984 and 1985 (Appendices C and D). We also observed 27 adult chinook which were staging in the SFSR prior to spawning. Age-I chinook were not susceptible to hook-and-line sampling (Table 6).

Cutthroat trout (cutthroat) were uncommon in the SFSR. In 1984 we observed 14 cutthroat in 23 transects and in 1985, 17 'cutthroat in 28 transects (Table 7). Densities averaged 0.03 per 100 m^2 of stream surveyed each year. Most (90%) of the cutthroat were observed below Elk Creek in the most inaccessible portions of the mainstem. Cutthroat comprised 3% of the game fish observed by snorkeling (Appendices C and D) and 3% of the game fish captured by hook-and-line (Table 6). In 1984, 50% of the cutthroat we observed exceeded 300 mm while in 1985, just 18% exceeded 300 mm. This represents a significant decline in the percentage of cutthroat in the sample larger than 300 mm (Chi-square, $p < .05$). Similarly, in 1984 most (80%) of the cutthroat caught in the SFSR were larger than 200 mm while in 1985, just 14% exceeded 200 mm representing a significant decline in the percentage of cutthroat larger than 200 mm (Chi-square, $p < .05$).

Table 6. Numbers of game fish sampled by hook-and-line in the South Fork Salmon River, August 1984 and 1985.

Year	Section	Steelhead parr	Rainbow trout	Cutthroat trout	Bull trout	Mountain whitefish	Other	Total game fish
1984	Lower (below China Creek)	55	2	4	0	0	0	61
	Middle (Sheep Cr. to Chine Cr.)	93	3	1	0	0	1 CK[a]	98
	Upper (Above Sheep Creek)	5	0	0	1	0	0	6
	Total	153	5	5	1	0	1 CK	165
1985	Lower	74	2	5	0	0	0	81
	Middle	199	0	2	0	0	0	201
	Upper	9	0	0	1	0	2 CK	12
	Total	282	2	7	1	0	2 CK	294
	Grand total	435	7	12	2	0	3 CK	459
	Percent	95%	2%	3%	<1%	0	<1%	

[a]CK = Juvenile chinook salmon

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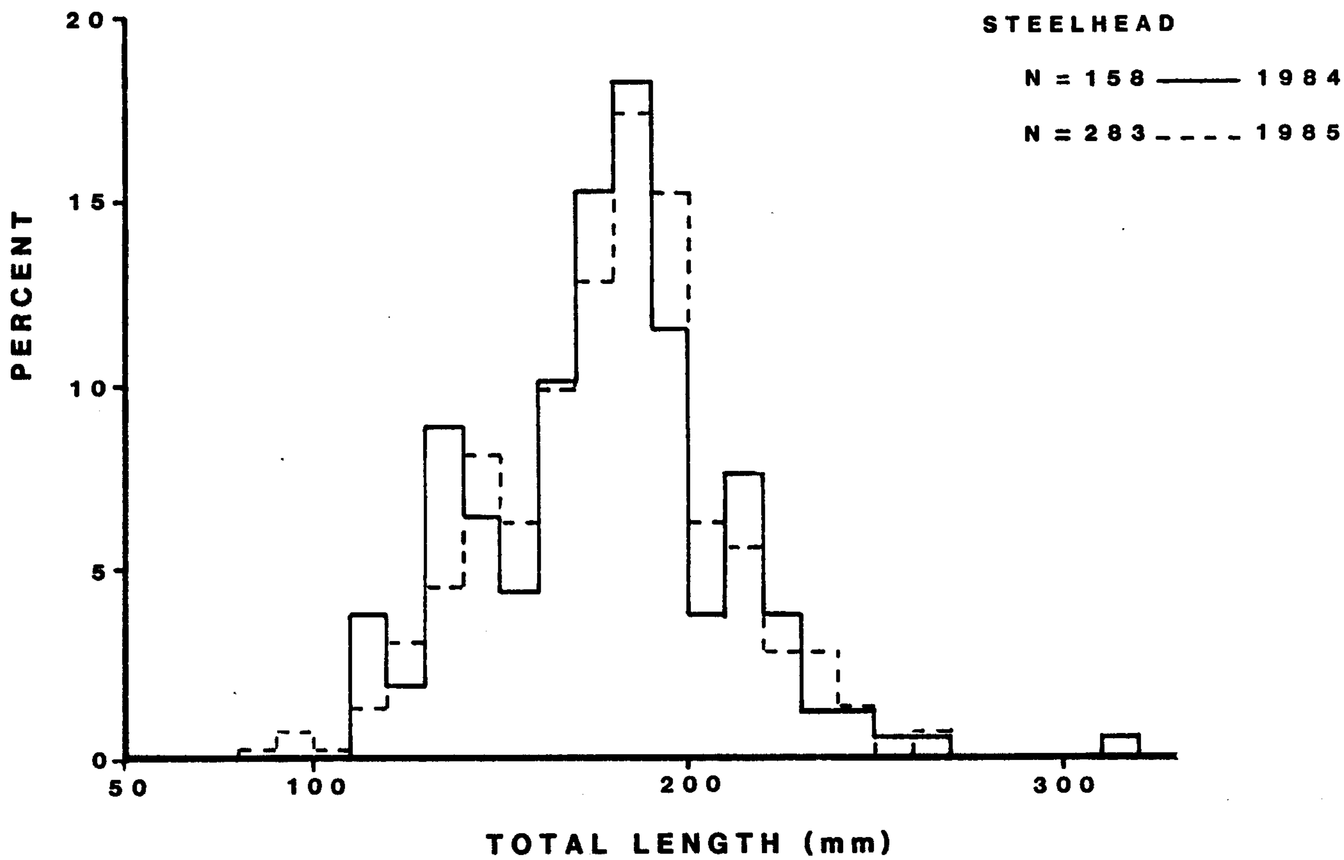

Figure 14. Length frequency of steelhead parr and rainbow trout (> 250 mm) caught in the South Fork Salmon River, August 1984 and 1985.

Table 7. Numbers and densities of chinook salmon, cutthroat and bull trout observed in South Fork Salmon River transacts, July-August 1984 and 1985.

	Chinook salmon				Cutthroat trout				Bull trout			
	1984		1985		1984		1985		1984		1985	
Transact	Age 0	Age 0/100 m²	Age 0	Age 0/100 m²	Total	Total/100 m²	Total	Total/100 m²	Total	Total/100 m²	Total	Total/100 m²
1	0	0.00	0	0.00	0	0.00	0	0.00	1	0.57	1	0.68
2	0	0.00	0	0.00	0	0.00	0	0.00	11	2.70	0	0.00
3	73	15.77	158	37.00	0	0.00	0	0.00	1	0.21	2	0.46
4	55	10.99	29	6.10	0	0.00	0	0.00	0	0.00	0	0.00
5	64	13.15	88	18.52	0	0.00	0	0.00	0	0.00	0	0.00
6	105	10.32	151	22.18	0	0.00	0	0.00	0	0.00	0	0.00
7	33	5.07	8	1.39	0	0.00	0	0.00	0	0.00	0	0.00
8	--	--	9	1.02	--	--	0	0.00	--	--	0	0.00
9	--	--	11	1.08	--	--	0	0.00	--	--	0	0.00
10	--	--	16	1.40	--	--	0	0.00	--	-	0	0.00
11	140	13.46	165	15.09	0	0.00	1	0.09	2	0.19	1	0.09
12	75	4.07	57	3.30	0	0.00	0	0.00	0	0.00	0	0.00
13	70	3.14	17	0.72	0	0.00	0	0.00	0	0.00	0	0.00
14	130	7.61	50	2.48	0	0.00	0	0.00	1	0.05	2	0.09
15	25	0.94	20	1.72	0	0.00	0	0.00	0	0.00	0	0.00
16	40	1.74	70	2.62	0	0.00	0	0.00	0	0.00	1	0.03
17	5	0.25	13	0.50	0	0.00	2	0.07	0	0.00	0	0.00
18	46	1.53	1	0.03	0	0.00	0	0.00	0	0.00	0	0.00
19	80	2.22	16	0.53	0	0.00	0	0.00	1	0.02	1	0.03
20	70	2.08	70	2.13	0	0.00	0	0.00	0	0.00	2	0.06
21	25	0.81	15	0.46	1	0.03	1	0.03	0	0.00	1	0.03
22	25	1.19	0	0.00	5	0.24	1	0.04	0	0.00	0	0.00
23	5	0.17	3	0.09	0	0.00	1	0.03	0	0.00	0	0.00
24	0	0.00	0	0.00	0	0.00	2'	0.05	0	0.00	0	0.00
25	3	0.10	5	0.16	2	0.07	2	0.06	0	0.00	0	0.00
26	4	0.12	8	0.26	1	0.03	2	0.06	0	0.00	0	0.00
27	2	0.07	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
28	7	0.27	1	0.03	5	0.19	5	0.18	0	0.00	0	0.00
Total	1082	x=2.17	981	1=1.91	14	1.03	17	1.03	17	x`=0.03	11	$\bar{x}$ =0.02

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Bull trout were observed in six transects in 1984 and eight transects in 1985 (Appendices C and D). Snorkeling did not provide a reliable estimator of bull trout abundance due to their sedentary behavior. Shepard et at. (1984a) also found that snorkel counts were inefficient for estimating abundance of juvenile bull trout. We observed bull trout ranging from less than 100 mm to 400 mm with 71% between 100 and 300 mm. Bull trout comprised 2% of the fish observed by snorkeling and less than 1% of the fish captured by hook-and-line (Table 6).

Other game fish we observed included: young-of-the-year salmonids, brook trout, and mountain whitefish (Appendices C and D). Young-of-the-year salmonids were most likely steelhead, cutthroat or rainbow trout. We observed them in nine transects in 1984 and 12 transects in 1985. Brook trout were present in three transects in 1984. Mountain whitefish were abundant in 20 of 23 transects in 1984 and 23 of 28 transects in 1985. We enumerated mountain whitefish in 1985 and counted an average of 35 per transect in areas below Cabin Creek. A sample of 168 mountain whitefish ranged from less than 230 mm to 380 mm and most (80%) exceeded 230 mm. No whitefish were captured with hook-and-line.

Tributaries

.... Steelhead parr were the most abundant and widely distributed age-I and older salmonid in SFSR tributaries. We snorkeled 89 transects in 11 tributaries in 1984 and 102 transects in 14 tributaries in 1985. Eighteen sections of eight additional tributaries were electrofished in 1985. All surveyed drainages (Bear, Blackmare, Buckhorn, Burntlog, Camp, Caton, Cougar, Dollar, Elk, Fitsum, Johnson, Lake,. Lick, Phoebe, Porphyry, Profile, Quartz, Raines, Riordan, Sheep, Sugar, Summit, Tamarack and Trapper creeks and the East Fork of the South Fork and Secesh rivers) supported steelhead parr in areas accessible to fish passage (Appendices E to G). Steelhead parr comprised 79% of the age-I and older salmonids observed by snorkeling in 1984 and 1985, and 65% of the age-I and older salmonids collected by electrofishing in 1984 and 1985 from accessible stream sections.

We located potential barriers to fish migration on upper sections of Buckhorn, Caton, 'Elk, Fitsum, Riordan, and Trapper creeks. A potential barrier on Johnson Creek was altered by blasting in 1984 and 1985 (Petrosky and Holubetz 1985). Resident rainbow trout comprised 46.5% of the salmonids observed above the barriers.

Transects ranged from 5 to 120 m long depending on the size of the stream (Appendices H to J). Rubble was the predominate substrate, followed by gravel and boulders. Water temperatures ranged from 7 to 20 C at the time transects were snorkeled.

Tributaries provide the principal rearing areas for steelhead parr in the SFSR as reflected in larger densities than in mainstem areas. Densities of steelhead parr ranged from 0 to 10.51 per 100 m^2 in accessible snorkeled tributary sections and averaged 2.57 per 100 m^2 (excluding the East Fork of the South Fork) (Appendix E). Densities of

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steelhead parr in accessible, smaller electrofished tributary sections ranged from 0 to 31.58 per 100 m^2 and averaged 3.34 per 100 m^2 (Appendix F). Within some tributaries, "pool" habitats supported larger densities than "pocket water" habitats.

We replicated counts of steelhead parr in sections of Johnson and Lick creeks and the Secesh River in 1984 and 1985 (Appendix E). Densities of age-I and older steelhead parr (fish per 100 m) were not significantly different between 1984 and 1985 ($p > .05$). Similarly, we replicated counts of steelhead parr in the East Fork of the South Fork in 1984 and 1985. Densities of age-I steelhead were not significantly different between 1984 and 1985 ($p > .05$). However, densities of age-II and age-III steelhead parr declined significantly from 1984 to 1985 ($p < .05$).

Angling was also effective in collecting data on tributary fish populations. Of 1,558 game fish captured by hook-and-line, 75% were steelhead parr (Appendix K).

Length-frequencies of steelhead parr were similar in 1984 and 1985 and most (90%) steelhead were less than 200 mm (Fig. 15). More steelhead parr less than 120 mm were captured with electrofishing and hook-and-line in 1985 than solely with hook-and-line in 1984. We also caught eight wild rainbow trout (> 250 mm) in tributaries. The age-frequency of steelhead parr observed by snorkeling equaled 45% age-I, 47% age-II and 8% age-Ill in 1984 and 40% age-I, 49% age-II and 10% age-Ill in 1985 (Appendix E).

Chinook were present in 17 streams in 1984 and 1985 (Appendices E and F). We observed 1,408 age-0, 72 age-I, and 5 adult chinook in 1984 and 1,381 age-0, 51 age-I, and 8 adult chinook in tributaries in 1985. Densities of age-0 chinook in snorkeled transects ranged from 0 to 11.29 per 100 m^2 in 1984 and 0 to 13.0 per 100 m^2 in 1985. Juvenile chinook were most abundant in low gradient channel areas with abundant pools. Platts and Partridge (1978) made similar observations. Snorkeled sections of Johnson and Lake creeks and the Secesh River supported the largest densities of age-0 chinook. Lower sections of Camp and Phoebe creeks supported the largest age-0 chinook densities in electrofished streams. Age-I chinook composed 4.5% of the age-I and older salmonids (observed by snorkeling and captured by electrofishing) in accessible stream sections. We captured 123 chinook which ranged from 50 to 170 mm (Fig. 16). Age-0 chinook ranged from 50 to 90 mm and age-I chinook from 90 to 130 mm. Chinook larger than 130 mm may have been precocial.

Cutthroat were uncommon in most areas of the tributaries. We observed 28 cutthroat in 1984 and 27 in 1985 in snorkeled tributaries (Appendix G). Twenty-four cutthroat were captured in electrofished tributaries (Appendix F). Sections of Bear Ill, Buckhorn, Burntlog, Camp, Dollar, Fitsum, Johnson, Lick, Phoebe, Profile, Raines and Tamarack creeks; and the East Fork of the South Fork and Secesh rivers supported cutthroat trout. Cutthroat comprised 2% of the fish observed by snorkeling and captured by electrofishing in tributaries. Densities of cutthroat in snorkeled transects ranged from 0 to 4.42 per 100 m^2 in 1984 and from 0 to 1.73 per 100 m^2 in 1985. In electrofished sections, cutthroat densities ranged from 0 to 5.19 per 100 m^2. Sections of Bear III, Burntlog, Profile, and Raines creeks; and the headwaters of the East Fork of the South Fork supported the largest densities of cutthroat.
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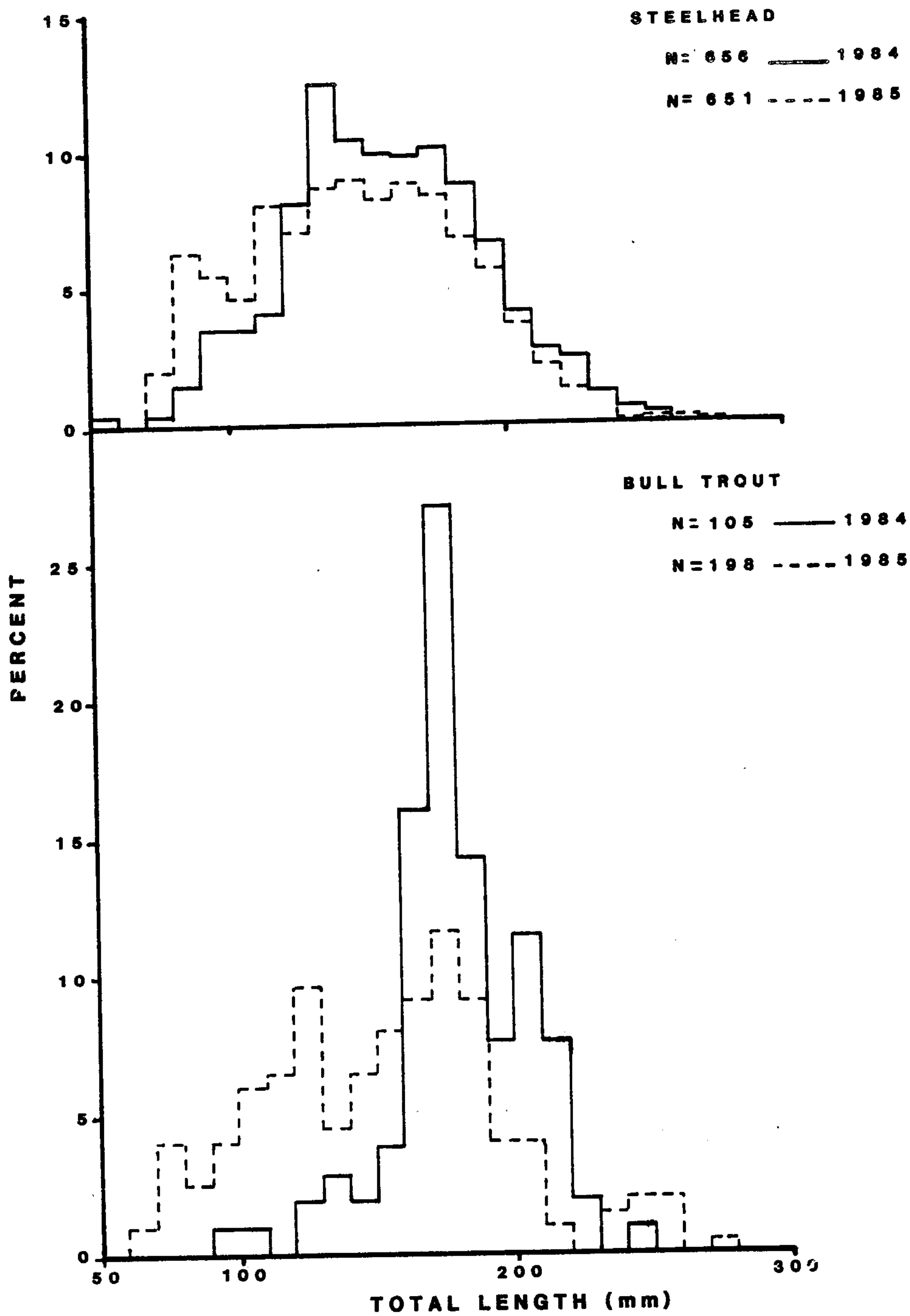

Figure 15. Length frequency of steelhead parr, rainbow trout (> 250 mm) and bull trout caught in South Fork Salmon River tributaries, 1984 and 1985.

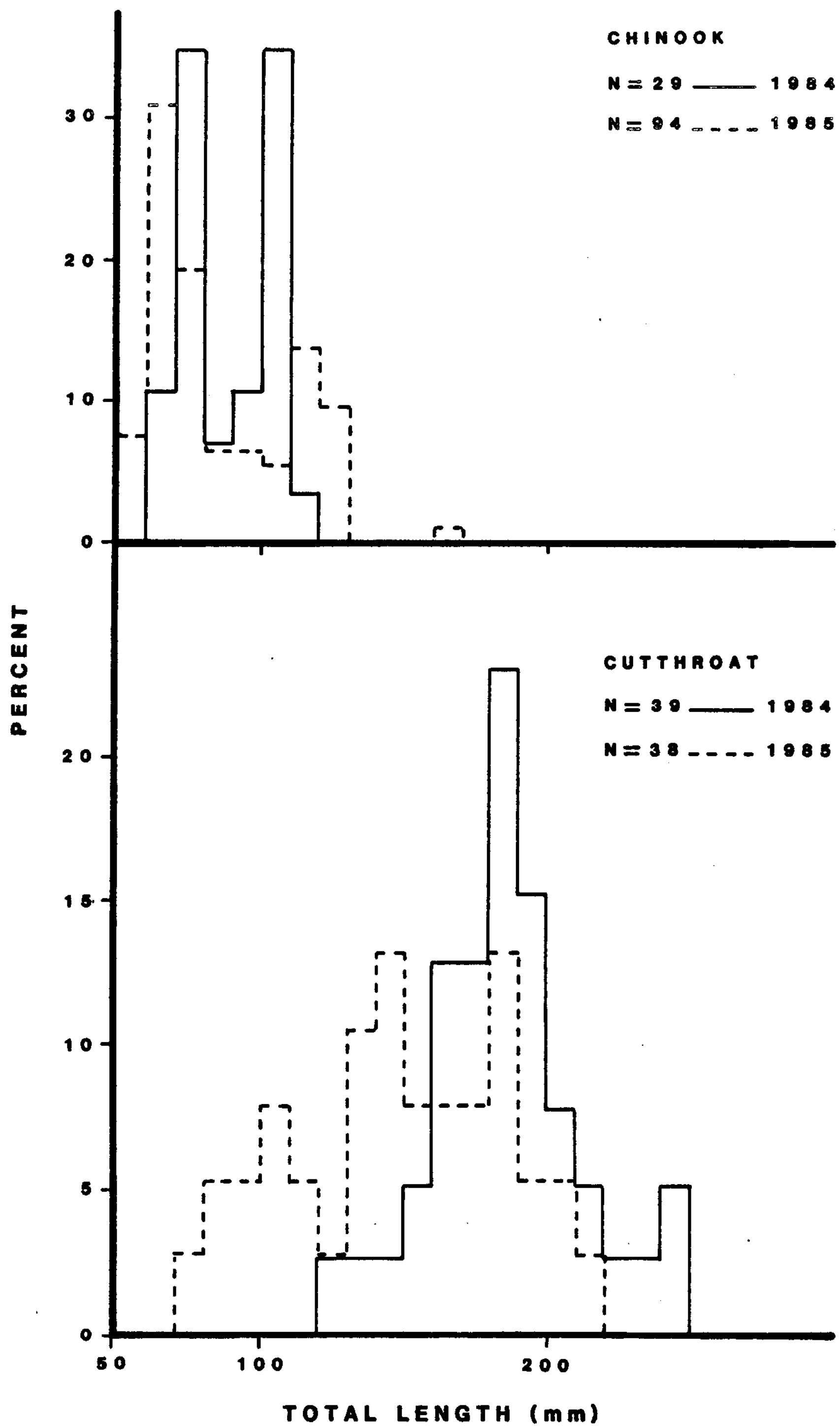

Figure 16. Length frequency of chinook salmon and cutthroat trout captured by hook-and-line and electrofishing in the South Fork Salmon River tributaries, 1984 and 1985.

Length frequencies of cutthroat observed by snorkeling in tributaries in 1984 and 1985, respectively, averaged 11% and 14% less than 100 mm, 64% and 50% 100 to 200 mm; 11% and 36% 200 to 300 mm, and 4% and 0% larger than 300 mm (Appendix G).

Cutthroat trout comprised 4% of the fish caught by hook-and-line in 1984 and 1985, (Appendix K). Cutthroat captured by hook-and-line and electrofishing ranged from 70 to 250 mm and most (91%) were less than 200 mm (Fig. 16).

Bull trout were present in 18 streams in 1984 and 1985 (Appendices F and G) and they comprised 9% of the fish observed by snorkeling or captured by electrofishing. We observed bull trout in both accessible stream sections and in sections of Buckhorn, Elk, Fitsum, and Trapper creeks above barriers. Densities of bull trout in snorkeled transects ranged from 0 to 3.91 per 100 m^2 in 1984 and from 0 to 5.16 per 100 m^2 in 1985. In electrofished sections, bull trout densities ranged from 0 to 11.42 per 100 m^2. Sections of Buckhorn, Burntlog, Quartz, Profile, Sugar, Tamarack, and Trapper creeks supported the largest densities of bull trout.

Length frequencies of bull trout observed by snorkeling in tributaries in 1984 and 1985, respectively averaged 20% and 19% less than 100 mm, 43% and 37% 100 to 200 mm, 21% and 34% 200 to 300 mm, 6% and 8% 300 to 400 mm, and 10% and 2% larger than 400 mm (Appendix F).

Bull trout comprised 14% of the fish caught by hook-and-line in 1984 and 1985 (Appendix K). Most bull trout captured by hook-and-line and electrofishing ranged from 60 to 100 mm (Fig. 15). We captured four bull trout between 400 and 490 mm. A majority (90%) of the bull trout in tributaries were less than 200 mm.

Other game fish we observed included mountain whitefish and brook trout. Mountain whitefish and brook trout were observed in eleven tributaries in 1984 and 1985 (Appendices F and G). Brook trout were most abundant in flat gradient areas of Johnson, Lake and Summit creeks. We captured 37 brook trout with hook-and-line which ranged from 95 to 220 mm and most (87%) were less than 200 mm (Appendix K). Hatchery-reared rainbow trout, stocked in 1984 and 1985, were observed in sections of Bear Ill, Johnson and Tamarack creeks and the East Fork of the South Fork and Secesh rivers.

Detailed Tributary Descriptions

More detailed descriptions of tributaries sampled in 1984 and 1985, and data from other studies, are provided in the next section. Refer to the following: Table 8 = fish species distribution, Appendix L = individual tributary fish counts, and Appendices M, N, O, P = length-frequency by species for individual tributaries. Location of individual tributary transects are recorded in the McCall IDGF Subregional Office files.

Table B. Existing data on fish species distribution in South Fork Salmon River tributaries (source: current study unless otherwise noted).

Tributary	Steelhead-rainbow	Chinook salmon	Cutthroat trout	Bull trou	Brook trout	Mountain whitefis
Bear I[a] (above Knox bridge)	X	X	--	X	X	--
Bear II (below Fritser Cr.)	X	--	--	--	--	--
BLackmare	X	X	--	X	--	X
Buckhorn	X	X	X	X		X
North Fork[a]						
South Fork[e]						
West Fork	X	X	X	X	–	
Cabin[a]	X	X	–	X	X	X
Camp	X	X	X	X	X	--
Cougar	X	X	--	X	X	--
Dollar	X	–	X	--	X	--
East Fork of the South Fork	X	X	X	X		X
Caton	X	–	--	--	–	–
Deadman[b]	X		–	–	–	–
Johnson (above Trout Cr.)	X	--	X	–	X	--
Johnson	X	X	X	X	X	X
Bear III	X	X	X		X	--
Burntlog	X	X	X	X	X	X
Riordan	X	--	--	X	--	--
Trapper	X	X	–	X	--	--
Parks[b]	X	–	X	X	--	x
Profile	X	--	X	X	--	X
Quartz	X	--	--	X	--	--
Reegan[b]	--	--	X	--	--	--
Sugar	X	--	–	X	--	--
Tamarack	X	X	X	X	--	X
Elk	X	--	--	X	--	--
West Fork	X	--	--	X	--	--
Fitsum	X	X	X	--	--	X
North Fork	X	--	X	X	--	--
Four Mile[a]	--	--	X	–	–	--
South Fork	--	–	X	X	–	--
Lodgepole[s]	X	X	–	X	X	X
Phoebe	X	X	X	–	X	X
Porphyry	X	–		–		
Raines	X	--	X	–	--	--
Roaring[a]	--	--	--	--	--	--

Table 8. Continued.

Tributary	Steelhead-rainbow	Chinook salmon	Cutthroat trout	Bull trout	Brook trout	Mountain whitefish
Secesh	X	X	X	X	X	X
Lake	X	X	–	X	X	X
Lick	X	X	X	X	--	X
Cly[a]	X	--	--	--	--	--
Duck Lake[s]	--	--	X	--	–	--
Summit	X	X	--	--	X	X
Sheep	X	X	--	--	--	–
Six-Bite[e]	X	--	--	X	--	--
Tailholt[a]	X	--	–	–	–	–
Trai l[a]	X	X	–	X	X	X
Curtis	X	X	X	X	X	--
Tyndall[a]	X	X	--	X	–	--

[a]Platts and Partridge (1979).

[b]Burns and Heagy (1982).

Bear Creek I (River km 123.5). Bear Creek I enters the mainstem SFSR above Knox Bridge, and was sampled by Platts and Partridge (1978).

Bear Creek _ II_(River km 41). Bear Creek II is a tributary to the mainstem SFSR. A natural rock barrier to fish migration exists within 1.5 km above the mouth. Suitable fish rearing habitat exists above and below the barrier.

Blackmore Creek __(River km 90). We electrofished in the lower 1 kilometer of Blackmare Creek (Appendix F).

Cabin Creek (River km 116). Platts and Partridge (1978) sampled Cabin Creek. Road culverts form a migration block at its confluence with the SFSR.

Camp Creek (River km 77). We electrofished sections of the lower 2 km of Camp Creek (Appendix F).

Cougar Creek (River km 79.5). Sections of the lower 3 km of Cougar Creek were electrofished (Appendix F).

Dollar Creek (River km 107). We electrofished in the lower two km of Dollar Creek (Appendix F).

Buckhorn Creek (River km 74). We snorkeled sections in the lower 12 km of Buckhorn Creek and the lower 4 km of its West Fork. A barrier to fish migration exists on the mainstem approximately 10 km above the SFSR. Platts and Partridge (1978) also sampled sections of the North and South forks of Buckhorn Creek.

East Fork of the South Fork (River km 56). We snorkeled sections between Fern Creek and the SFSR. The stream contains extensive rearing habitat for resident and anadromous fish below Tamarack Creek (Fig. 17). Above Sugar Creek, the East Fork of the South Fork has been adversely impacted by precious metal mining. Sections of the original channel have been altered and a barrier to fish migration exists. Other biologists reported cutthroat, bull and hatchery rainbow trout within the stream above Sugar Creek in 1979 (Desert Research Institute 1979).

Caton Creek. Caton Creek enters the'East Fork of the South Fork 16 km above its confluence with the SFSR. We snorkeled sections of Caton Creek between Caton Lake and the East Fork of the South Fork. A natural barrier exists approximately 4.5 km above the mouth.

Deadman Creek. Deadman Creek enters the East Fork of the South Fork 9 km above its confluence with the SFSR, and was surveyed by Burns and Heagy (1982).

Johnson Creek. Johnson Creek enters the East Fork of the South Fork 22.5 km above its confluence with the SFSR and is 61 km long. It is a large stream with an annual average flow of 354 cfs (US Geological Survey 1983). We snorkeled sections of Johnson Creek below Trout Creek. Petrosky and Holubetz (1985) surveyed additional

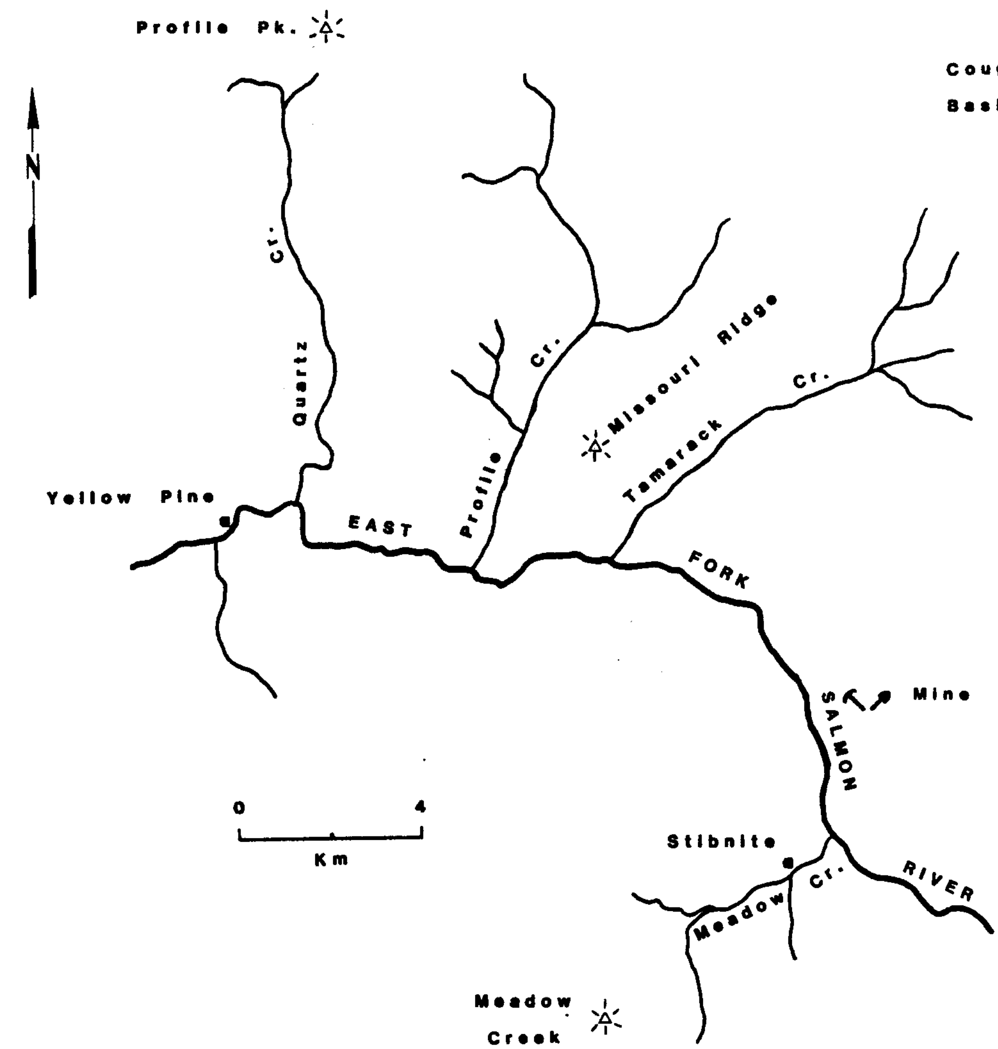

Figure 17. Map of the upper East Fork of the South Fork Salmon River near Stibnite, Idaho.

sections of Johnson Creek between Tyndall Meadows and Trout Creek. Potential barriers to fish migration were altered by blasting near the mouth of Trout Creek in 1984 (Petrosky and Holubetz 1985).

Bear Creek Ill. Bear Creek Ill is a tributary to Johnson Creek and enters 13 km above the mouth. We electrofished the lower three km of the stream (Appendix F).

Burntloq Creek. Burntlog Creek enters Johnson Creek 22 km above the mouth. We snorkeled sections of the lowermost 15 km of the stream.

Riordan Creek. Riordan Creek enters Johnson Creek 6.5 km above the mouth. We snorkeled sections of the lowermost 4 km of the stream. A potential barrier to fish migration exists 2.5 km above Johnson Creek.

Trapper Creek. Trapper Creek enters Johnson Creek 18 km above the mouth. We electrofished sections of the lowermost 6.5 km of the stream. A potential barrier to fish migration exists 0.8 km above Johnson Creek.

Parks Creek. Parks Creek enters the East Fork of the South Fork 20.5 km above its confluence with the SFSR, and was surveyed by Burns and Heagy (1982).

Profile Creek. Profile Creek enters the East Fork of the South Fork 32 km above its confluence with the SFSR. We snorkeled sections of the lower 10 km of the stream.

Quartz Creek. Quartz Creek enters the East Fork of the South Fork 27 km above its confluence with the SFSR. We snorkeled sections of the lower 6 km of the stream.

Reegan Creek. Reegan Creek enters the East Fork of the South Fork 16.5 km above its confluence with the SFSR, and was surveyed by Burns and Heagy (1982).

Sugar Creek. Sugar Creek enters the East Fork of the South Fork above its confluence with the SFSR. We electrofished sections of the lower 41 km of the stream (Appendix F).

Tamarack Creek. Tamarack Creek enters the East Fork of the South Fork 36.5 km above its confluence with the SFSR. We snorkled sections of the lower 7.5 km of the stream.

Elk Creek (River km 34.5). We snorkled sections of the lower 7 km of Elk Creek and 4 km of the West Fork Elk Creek. Potential barriers to fish migration exist on Elk Creek 7 km above the mouth and on the West Fork Elk Creek 0.7 km above the mouth. Chinook salmon were reported in Elk Creek in the past. L.G. Caswell killed a "2 1/2 foot" salmon in Elk Creek near the forks on November 9, 1899 (Caswell 1900).

Fitsum Creek (River km 62). We snorkeled sections of the lower 11 km of Fitsum Creek and the lower 5 km of the North Fork Fitsum Creek. A barrier to fish migration exists on Fitsum Creek 6 km above the mouth. The stream is devoid of fish above that point and supports a population of tailed frogs.

Fourmile Creek (River km 86). Platts and Partridge (1978) sampled the stream. We observed a steelhead redd in lower Fourmile Creek in 1984.

Lodgepole Creek (River km 129). Platts and Partridge (1978) sampled the stream.

Phoebe Creek (River km 77). We electrofished sections of the lower 2 km of the stream. Golden trout (Salmo aquabonita) were stocked in Phoebe Meadows (6.5 km above the mouth) in 1976 (Pollard 1983).

Porphyry Creek (River km 16). We snorkeled the lower 2 km of the stream.

Raines Creek (River km 7). We snorkeled the lower 2 km of the stream.

Secesh River (River km 55). The Secesh River is the second largest SFSR tributary. We snorkeled sections of the lower 40 km of the Secesh River.

Lake Creek. Lake Creek Joins Summit Creek to form the Secesh River. We snorkeled sections in the lower 5 km of the stream.

Lick Creek. Lick Creek enters the Secesh River 6.5 km above its confluence with the SFSR. We snorkeled sections of the lower 4.5 km of the stream. Platts and Partridge (1978) also surveyed Cly and Duck Lake creeks, tributaries to Lick Creek.

Loon Creek. Loon Creek flows through Loon Lake and is a tributary to the Secesh River 23 km above the confluence with the SFSR. Several hundred adult kokanee salmon (Oncorhynchus nerka) were observed in Loon Creek above the lake on August 7, 1984. We also observed bull and brook trout and mountain whitefish in the lake.

Summit Creek. Summit Creek Joins Lake Creek to form the Secesh River. We snorkeled sections of the lower 9.5 km.

Sheep Creek (River km 51). We snorkeled the lower 3.5 km of the stream.

Six-Bit Creek (River km 113)
Tailholt Creek (River km 55)
Trail Creek (River km 118.5)
Tyndall Creek (River km 131). Platts and Partridge (1978) sampled these four streams.

Age and Growth

Cutthroat Trout

Thirty-nine westslope cutthroat trout were collected for scale analyses from the mainstem SFSR and tributaries. Fish ranged from 140 to 352 mm and included Juveniles and adults. Failure to form a first annulus during the initial year of life is common in cutthroat from cold waters. As Mallet (1963) observed, spawning may be delayed and late hatching individuals may not form a first annulus. Scales from SFSR cutthroat contained between two and seven circuli to the first annulus in a normal distribution. Mallet (1963) and Fraley et al. (1981) reported three to 12 and less than seven circuli inside the first annulus in normal westslope cutthroat scales from the Middle Fork Salmon River, Idaho and Flathead River, Montana, respectively.

Due to an insufficient sample size, we combined samples for individual tributaries and the mainstem to a single growth model. This relationship was best described by the third degree polynomial:

$$\text{Total length} = 36.58 + 4.97\ \text{ASR} - .03\ \text{ASR}^2 + 1.89 \times 10^{-4}\ \text{ASR}^3 \text{ (Appendix Q).}$$

Due to the absence of cutthroat less than age-Ill in the sample, the regression equation does not reliably describe the body-scale relationship of trout less than age-Ill. As Johnson and Bjornn (1978) observed, the absence of small fish in age-growth data create a positive bias. Consequently, our calculated length at age-1 (87 mm) may be too large. We rejected the body-scale regression equation and applied a direct proportion formula:

$$L\sim = \frac{S'}{S} L$$

where L' = computed length at annulus
L = total length at capture
S' = radius of scale at annulus
S = radius of scale at capture

Growth of cutthroat trout in the South Fork Salmon River and tributaries was very similar to that described for westslope cutthroat from other areas of Idaho and Montana (Table 9). Juvenile cutthroat grew to average lengths of 51, 92, and 137 mm at age-I, II and Ill, respectively.

Annual growth increments averaged 51 mm the first year and declined to 41 and 46 mm the next two years (Table 9). After the third year, average incremental growth increased to 67 and 83 mm. Increased growth after age-II may reflect movement of some fish from tributaries into the mainstem SFSR and Salmon River. Mallet (1963) observed similar increments of growth in years I, it and III in the Middle Fork Salmon River.

Comparison of length-at-age for cutthroat in the SFSR with Mallet's data illustrates similar growth rates during initial years of life. We were not able to estimate length-at-age for fish older than age-IV. If

Table 9. Mean calculated total lengths and increments of growth for wild cutthroat trout collected in the South Fork Salmon River and tributaries, 1985 and comparison of backcalculated lengths to cutthroat trout from selected waters.

Location	Age group	Calculated mean total length (mm) at annulus							Reference
		N	1	2	3	4	5	6	
	II	4	57	101					
	III	18	51	93	141				
	IV	15	49	90	134	204			
	V	2	49	82	119	161	244		
Weighted grand average			51	92	137	199	244		
Number of fish			(39)	(39)	(35)	(17)	(2)		
Increment of growth (weighted)			51	41	46	67	83		
<u>Rivers</u>									
Middle Fork Salmon River, Idaho		474	57	95	165	241	305	352	Mallet (1963)
St. Joe River, Idaho		446	67	104	162	222	287	308	Johnson and Bjornn (1978)
Kelly Creek, Idaho		208	66	101	153	213	251	306	Johnson and Bjornn (1978)
Mainstem Flathead River, Montana		250	55	103	157	242	305	336	Shepard at al. (1984e)
North Fork Flathead River, Montana		197	54	97	138	166	214		Shepard at al. (1984a)
<u>Tributaries</u>									
St. Joe River, upper			53	102	152	224			Averette (1963)
St. Joe River, lower			71	135	226	292			Averette (1963)
North Fork Flathead River		1820	54	100	145	189	247		Shepard et al. (1984a)
Middle Fork Flathead River		880	54	100	149	205	254	293	Shepard at at. (1984a)

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the curve slope for the Middle Fork Salmon River remains similar at older age classes, average lengths of 270 and 320 would be expected at age-V and VI. Additional data are necessary to estimate length-at-age for fish older than age-IV.

Bull Trout

Scales were collected and analysed from 100 bull trout in the mainstem SFSR and tributaries. Fish ranged from 144 to 501 mm and included juveniles and adults. Scales were not readable (due to scale reabsorption) for several fish larger than 480 mm. Due to insufficient sample size, we combined samples for individual tributaries and the mainstem to a single growth model. This relationship was best described by the third degree polynomial:

Total Length = $22.6 + 4.36\ ASR + .02\ ASR^2 - 7.13 \times 10^{-5}\ ASR^3$ (Appendix R).

Juvenile bull trout grew to average lengths of 68, 110 and 154 mm at age-I, II and Ill, respectively (Table 10). Early growth of bull trout in the SFSR was similar to growth observed in the North Fork Flathead River, Montana. Shepard et al. (1984a) suggested that juvenile bull trout growth was enhanced in cooler tributaries. McPhail and Murray (1979) found bull trout fry grew to larger sizes as water temperatures decreased to 4 C. A majority of the bull trout we collected were in headwater areas of tributaries or in cooler tributaries of the East Fork of the South Fork.

Annual growth increments averaged 68 mm the first year and declined to 42 and 45 mm the next two years (Table 10). After the third year, average incremental growth Increased to 63 and 67 mm. The increased growth after age-Ill may reflect movement of some fish from tributaries into the mainstem SFSR and Salmon River. Shepard et al. (1984a) observed similar increments of growth in years I, II and Ill with increased growth after age-III. However, bull trout in the Flathead River basin migrated to Flathead Lake where growth during age-Ill increased to 128 to 146 mm.

Comparison of length-at-age for bull trout in the SFSR with the Flathead River in Montana illustrates similar growth to age-Ill with slower growth in the SFSR after age-III (Fig. 18). I attempted to extrapolate length at age-VI and older onto the graph from length frequency data. The resultant plot suggests average lengths of 350, 440, and 530 mm at age-VI, VII and VIII, respectively. Additional data are necessary to estimate length-at-age for fish older than age-IV. Due to the difficulty encountered when aging scales from fish four years and older, it is suggested that otoliths be collected when feasible.

Table 10. Mean calculated total lengths and increment of growth for wild bull trout collected in the South Fork Salmon River and tributaries 1985 and comparison of backcalculated lengths to bull trout from selected waters.

Location	Age group	Calculated mean total length (mm) at annulus N	1	2	3	4	5	6	Reference
	II	12	66	115					
	III	47	66	105	149				
	IV	20	72	117	167	223			
	V	21	69	109	154	211	284		
Weighted grand average			68	110	154	217	284		
Number of fish			(100)	(100)	(88)	(41)	(21)		
Increment of growth			68	42	45	63	67		
North Fork Flathead River, Montana 1977-1982			71 (820)	117 (478)	171 (109)	317 (30)			Shepard at al. (1984a)
Middle Fork Flathead River, Montana 1981-1982			51 (456)	96 (407)	152 (234)	284 (52)			Shepard at al. (1984a)
Upper Flathead Basin, Montana combined 1977-1982			65 (870)	108 [594)	160 (220)	288 (61)			Shepard at al. (1984a)

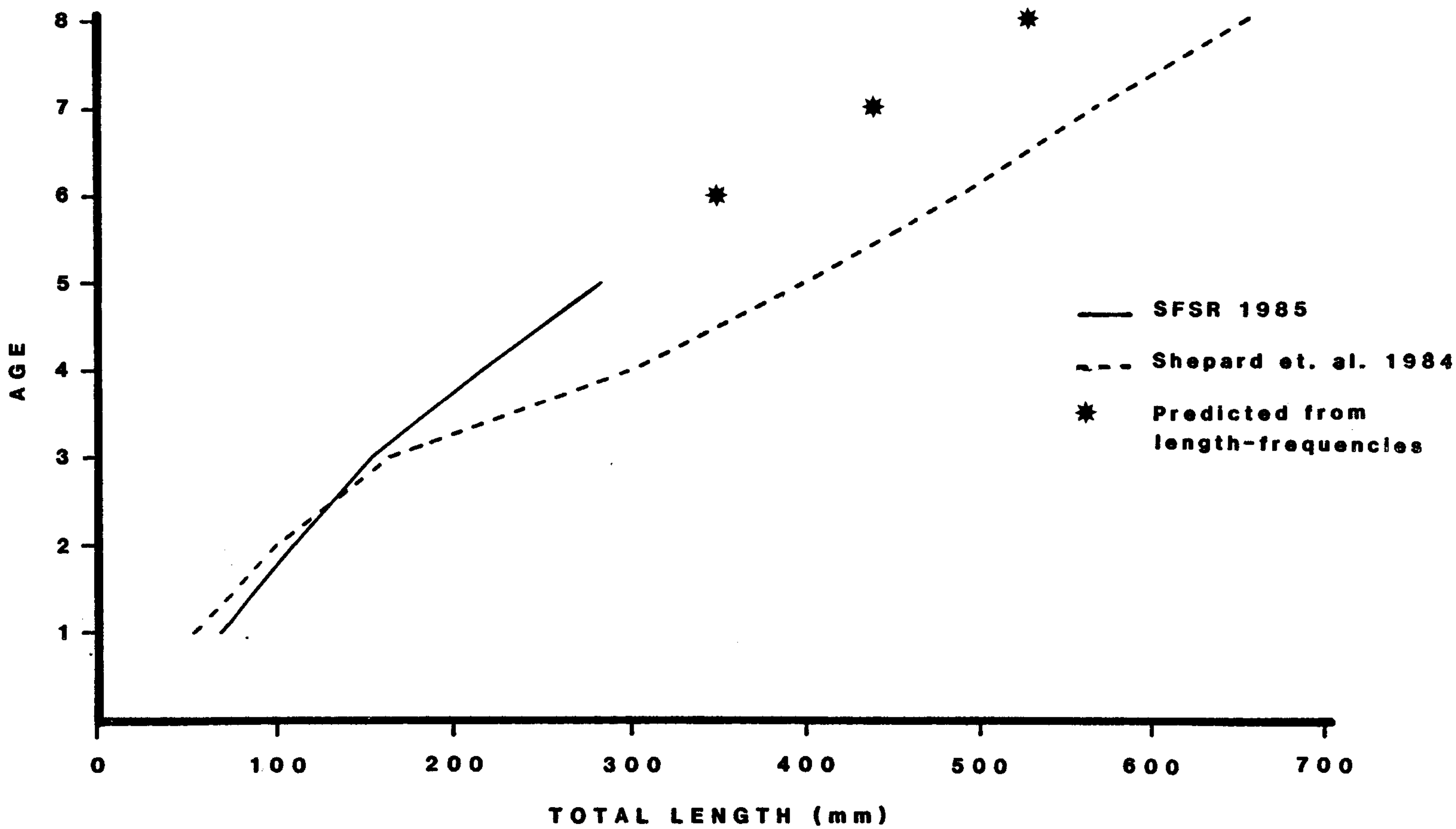

Figure 18. Length at age for bull trout from the South Fork Salmon River, Idaho and Flathead River, Montana (Shepard et al. 1984a).

Angler Use and Harvest

Angler Effort

Bank anglers fished an estimated 6,553 hours on sections 1 through 5 of the upper SFSR, East Fork of the South Fork and Johnson Creek from June 30 to September 21, 1984, and 11,634 hours on sections 2 through 5 from May 25 to September 13, 1985 (Appendix S and Fig. 19).

Angler effort increased in 1985, particularly during the period from mid-July to early August (Fig. 20). Effort was similar in 1984 and 1985 during early July and from early August to early September. In 1984 we did not survey anglers prior to June 30 due to unfavorable (high and turbid) water conditions. In 1985, conditions were more favorable so we initiated the census in late May.

Angler effort was largest on the East Fork of the South Fork during both years. In 1984 and 1985, 65% and 64% of the effort, respectively, occurred in sections 3 and 4 combined (Appendix S). Effort was smallest in section 2 (Knox Bridge to Three Mile Creek) during 1984 (17%) and 1985 (15%).

Harvest

Harvest rates for all species combined in 1984 varied from 0.09 fish per hour in section 1 to 1.01 fish per hour in section 5 (Appendix T). In 1985, harvest rates (fish/hour) varied from 0.39 in section 2 to 0.75 in section 4. Sections 3, 4 and 5 supported harvest rates exceeding 0.6 fish per hour in both years. Catch rates (harvest and release) ranged from 0.09 to 2.05 fish per hour in 1984 and from 1.57 to 1.84 fish per hour in 1985.

Anglers harvested approximately 5,256 and 7,949 game fish in 1984 and 1985, respectively (Table 11). Steelhead parr comprised a majority of the harvest (48%) for the two years combined. The harvest of hatchery-reared rainbow trout varied considerably between 1984 and 1985. In 1984, hatchery-reared trout comprised 53% of the harvest and an estimated 58% returned to the creel from 4,800 fish stocked. In 1985, hatchery-reared rainbow trout comprised 20% of the harvest and an estimated 33% returned to the creel from 4,800 fish stocked. Welsh (1969) reported a 43% return to the creel of hatchery-reared rainbow trout stocked• in the East Fork of the South Fork in 1968. Several variables differed between the fish stocked in 1984 and 1985 which may account for differences in return to the creel. One half of the fish stocked in 1985 were released two weeks earlier (June 20) than fish stocked in 1984 (July 2). Differences in stream discharge and temperature in June may have caused fish to be less available when angler effort increased in early July. In 1984, hatchery-reared rainbow trout comprised 58% of the fish caught prior to August 1 while in 1985 hatchery-reared rainbow comprised 14% of the fish caught prior to August 1. Although the number of fish planted was equal, fewer hatchery-reared rainbow were available to anglers in 1985.

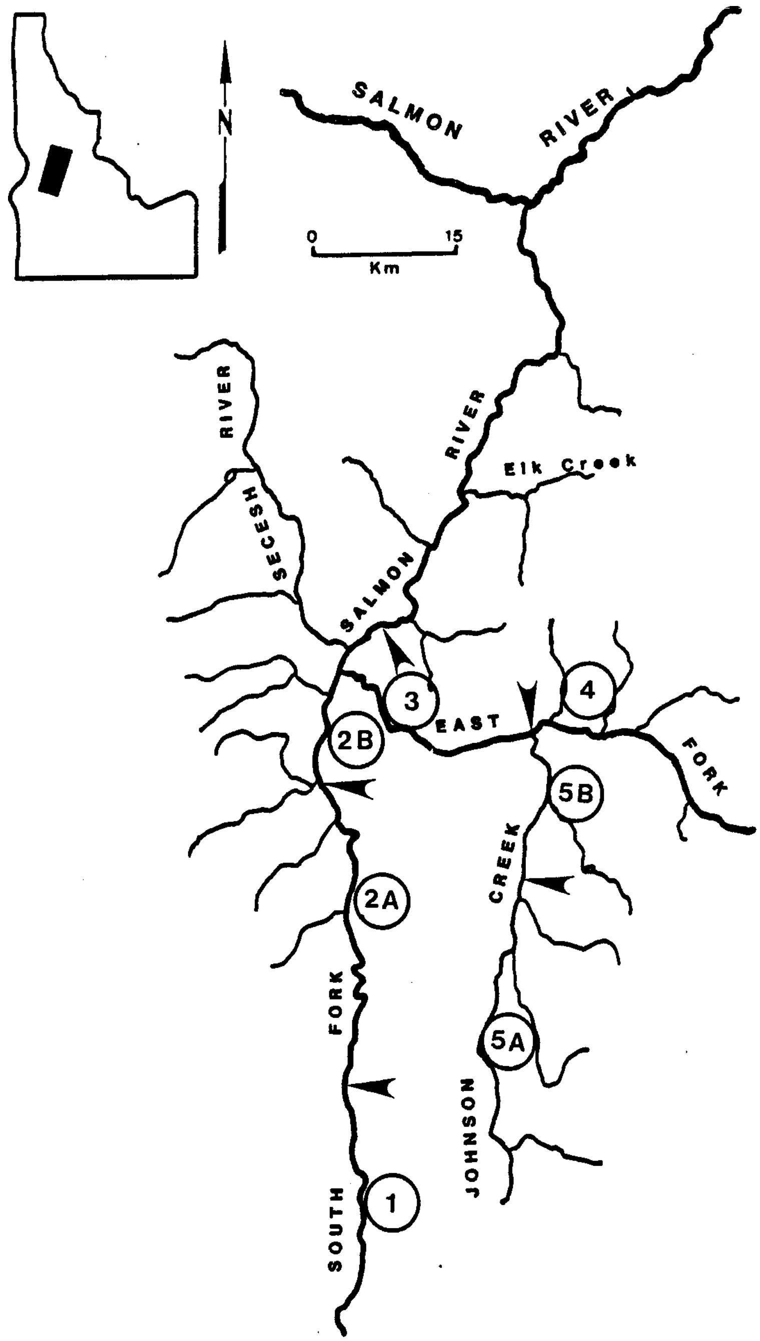

Figure 19. Map of creel census sections on the upper South Fork Salmon River, East Fork of the South Fork, and Johnson Creek, Idaho.

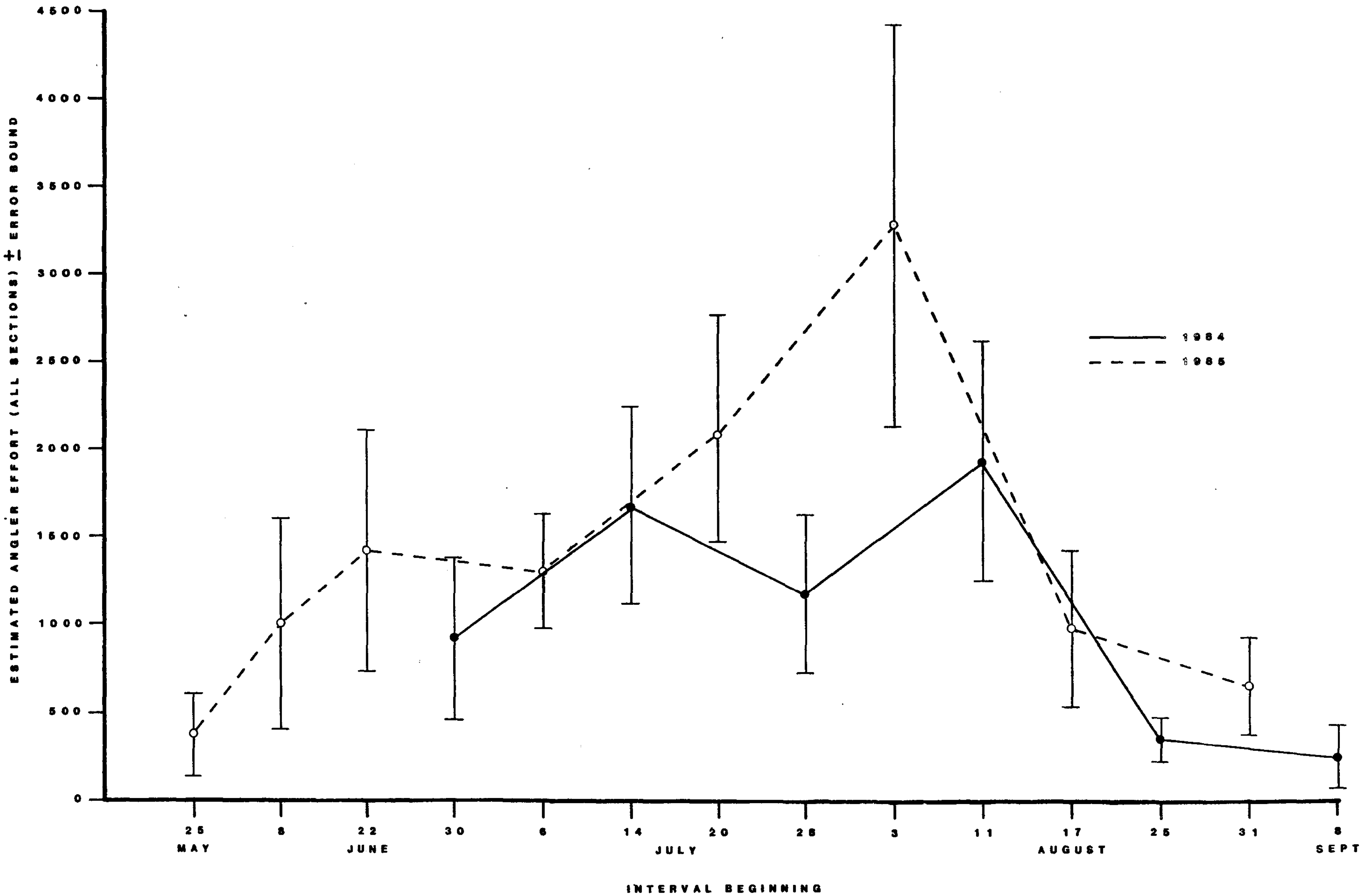

Figure 20. Estimated angler effort by interval on the South Fork Salmon River, 1984.

Table 11. Estimated harvest of game fish (by species) by bank anglers from the South Fork Salmon River, 1984 and 1985.

Section	Hatchery rainbow trout	Steelhead parr	Wild rainbow trout	Bull trout	Cutthroat trout	Mountain whitefish	Total estimated harvest	+ error bound
	Harvest by species							
1984 Data								
1	0	8	0	0	0	0	8	(34)
2	0	407	37	127	55	78	704	(528)
3	857	444	38	156	31	32	1558	(803)
4	1215	362	56	228	0	38	1899	(1195)
5	717	307	19	44	0	0	1087	(883)
Total	2789	1528	150	555	86	148	5256	(3443)
1985 Data								
2A	0	116	23	17	6	0	162	[183)
28	30	184	51	61	71	71	470	(301)
Total 2	30	300	74	78	77	71	632	(484)
3	66	2,236	268	362	131	56	3,119	(1,346)
4	991	1,063	127	153	26	36	2,394	(1,300)
5A	447	1,170	54	10	10	42	1,734	(1,005)
58	44	9	0	0	0	18	70	(67)
Total 5	491	1,179	54	10	10	60	1,804	(1,072)
Total 2-5	1,578	4,778	523	603	244	223	7,949	(4,202)

Further, the fish were reared at different facilities in 1984 and 1985 and differences in fish health are unknown. Hatchery rainbow trout ranged from 140 to 310 mm (Fig. 21).

Wild rainbow trout comprised 3% and 7% of the catch in 1984 and 1985, respectively. Steelhead parr ranged from 120 to 250 mm and rainbow trout ranged from 250 to 340 mm (Fig. 21). Anglers apparently released many wild fish less than 200 mm; 44% of those harvested were less than 200 mm as compared to 81% of those caught by project personnel (Fig. 14). Length-frequencies of angler-caught steelhead parr were nearly identical in 1984 and 1985.

Bull trout comprised 11% and 8% of the fish harvested in 1984 and 1985, respectively, in all sections combined and were most prevalent in sections 2, 3 and 4 (Table 11). Anglers captured bull trout of several size classes, ranging from 150 to 690 mm (Fig. 22). Bull trout supply a "trophy-sized" fishery as 49% exceeded 500 mm in 1984 and 1985 combined.

Cutthroat trout comprised 2% and 3% of the harvest in 1984 and 1985, respectively, and were captured in sections 2 and 3 (Table 11). The few cutthroat we measured (N = 31) ranged from 200 to 360 mm. Mountain whitefish comprised 3% of the harvest during the census period in 1984 and 1985.

Angler Attributes

Resident anglers comprised a majority (88% and 83%) of the anglers we interviewed on the SFSR in 1984 and 1985, respectively (Table 12). All anglers fished from the bank and most (58%) used bait.

A large proportion of the total catch was released. In 1984 and 1985, respectively, 48% and 63% of the catch was released. Many anglers who released fish indicated they released "small" wild fish (probably steelhead parr). The largest rate of release (fish released per hour) occurred in sections 2, 4 and 5 (Appendix S).

Genetic Characteristics of Steelhead

Preliminary electrophoretic analysis was completed on samples collected from the SFSR in 1984 and 1985. Twenty-one enzyme systems were analyzed. Schreck et al. (1985) reported calculated chi-square values comparing individual enzyme systems between Middle Fork Salmon and South Fork Salmon river steelhead trout. Enzymes ACO, IDH-3,4, MDH and GPI-1 were significantly different between the two samples. A significant difference in enzyme systems indicates genetic isolation between the two populations. Samples from the Secesh River and Johnson Creek were also compared. Populations were very similar although a significant difference occurred at the PEP-GL enzyme system suggesting heterogeneity of the populations.

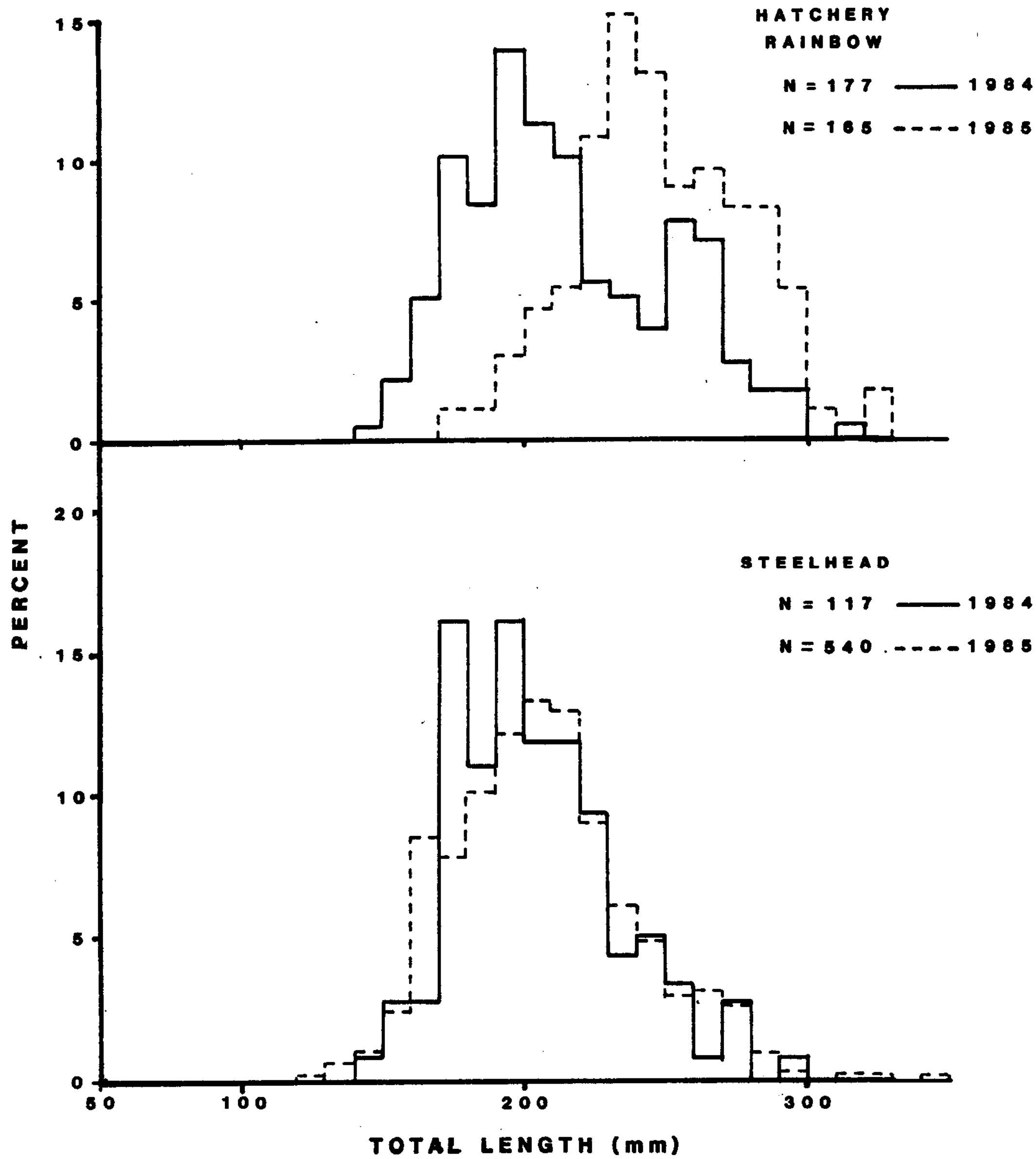

Figure 21. Length frequency of catchable rainbow trout, steelhead parr and wild rainbow trout (> 250 mm) caught by anglers from the South Fork Salmon River, 1984.

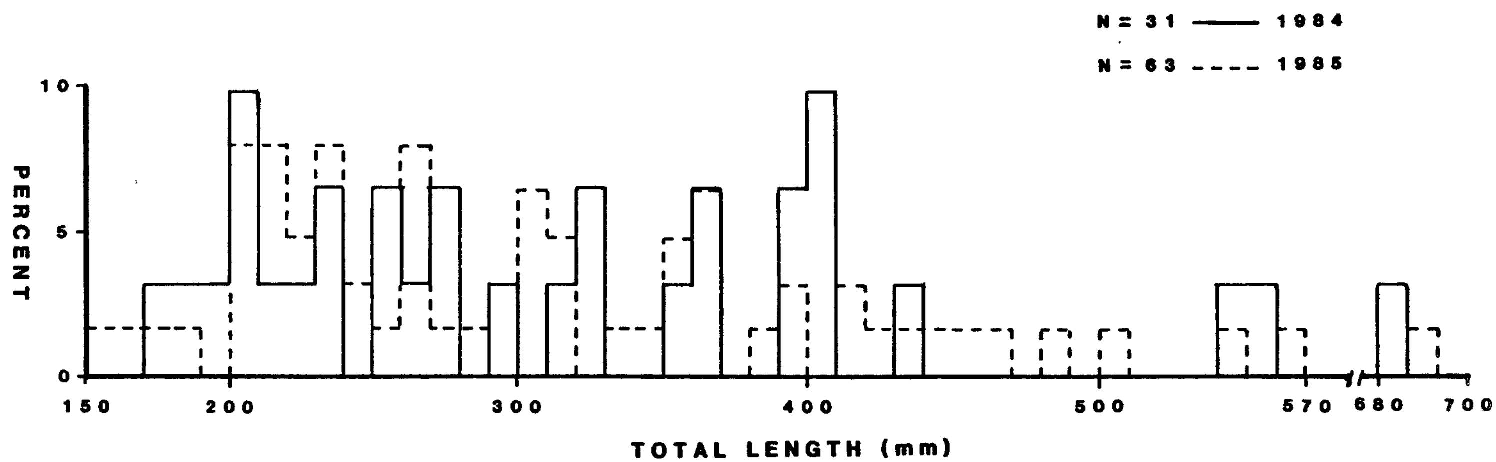

Figure 22. Length frequency of bull trout caught by anglers from the South Fork Salmon River, 1984 and 1985.

Table 12. Angler residence and methods used on the South Fork Salmon River, 1984 and 1985.

Section	Total anglers interviewed	Percent anglers resident	Percent anglers non-resident	Percent methods bait	Percent methods lure	Percent methods fly	Percent methods multiple
<u>1984 Data</u>							
1	13	100	0	100	0	0	0
2	83	82	18	59	30	10	2
3	120	88	12	63	18	14	4
4	71	97	3	65	19	12	4
5	49	80	20	78	12	8	2
Total (1-5):	316	88%	12%	66%	19%	9%	6%
Secesh River: mouth to Lick Creek	25	80	20	40	16	32	12
Profile Creek: lower 2km	2	100	0	100	0	0	0
<u>1985 Data</u>							
2A	50	88	12	55	19	18	10
28	132	73	27	46	31	15	8
3	334	84	16	51	22	15	12
4	205	87	13	58	16	19	9
5A	43	91	9	63	12	16	9
5B	144	82	18	63	8	9	17
Total	908	83%	17%	55%	19%	15%	11%

Cluster analysis illustrated that SFSR drainage summer steelhead populations are similar to other Salmon and Clearwater river wild stocks sampled. These include populations found in Chamberlain, Horse and Sheep creeks and the Middle Fork Salmon and Selway rivers. Steelhead populations from the Lochsa River and Dworshak and Pahsimeroi hatcheries clustered separately. Additional cluster analysis based on a combination of life history, morphometric, meristic and electrophoretic characters will be included in a later report of work being done under contract by the Bonneville Power Administration.

DISCUSSION

Status of Indigenous Steelhead

The SFSR drainage formerly supported a steelhead trout population with an estimated annual escapement of 3,000 or more (IDFG 1984). As a consequence of severe habitat degradation (Corley 1976) and mortality on steelhead smolts migrating from Idaho to the Pacific Ocean (Raymond 1979), the population declined to fewer than 500 fish by 1977 (Anonymous 1977).

Passage improvements and intensive steelhead management in Idaho have attempted to rebuild the SFSR steelhead population in recent years. Smolt to adult survival rates to the upper Salmon River have increased from 0.03 in 1977 to 1.8 and 1.01 for hatchery steelhead brood years 1980 and 1981, respectively (Ball 1984, 1985). The return of one-ocean adults from the 1982 brood year totaled 2.4% (K. Ball, IDFG, personal communication). The lower rate of descaling of wild steelhead smolts sampled in Salmon River downstream migrant studies suggests that wild smolts may have improved survival as compared to hatchery smolts (Scully et al. 1983). Wild steelhead catch and release regulations initiated on the Salmon River in 1982 have also decreased angling mortality (Thurow 1985).

An improved escapement to the SFSR has occurred since 1977 and some improvement apparently occurred from 1983 to 1985. Within the index area between Miners bridge and Knox bridge, we observed 230 steelhead redds on successive counts up to May 11, 1984 as compared to 71 redds observed by Reid and Anderson (1984) during a single count on May 14, 1983. Escapements in 1985 were not significantly different from escapements in 1984. We estimated that 800 adults spawned in the SFSR in 1984 and 900 adults in 1985.

The. goal of fishery managers in Idaho is to rebuild the steelhead population in the SFSR sufficiently to maintain the population and restore sport fishing opportunities. It is generally accepted among geneticists and biologists that indigenous stocks are best adapted for restoration of fish populations in a specific drainage. As Horrall (1981) observed, remnant stocks of a species should be protected and encouraged as they offer the most rapid means of rehabilitation. The concepts of genetic adaptation to a specific environment as reviewed by Ricker (1972) and the Stock Concept International Symposium (1981) illustrate that such adaptation results in maximum survival in a specific environment. Ir addition to their importance to restoring individual wild populations,

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maintenance of wild gene pools also offers a means of increasing the viability of future hatchery stocks for use in other drainages (Stock Concept International Symposium 1981). In recognition of these principles, Idaho's Anadromous Fish Management Plan recommends that the SFSR be managed for the production and preservation of wild, indigenous steelhead (IDFG 1984).

In the past, non-indigenous, hatchery-reared steelhead trout from Dworshak National Fish Hatchery were planted in the SFSR. Approximately 600,000 fry were stocked in 1977 and 480,000 fry in 1978. Initial mortality is very large on stocked fry. In Lochsa River tributaries, Graham (1977) found 6-8% survival of stocked fry. Within the Lemhi River, a very productive stream as compared to the SFSR, Bjornn (1978) estimated 80-90% density independent mortality on stocked fry. A steelhead research project on Washington's Kalama River suggested that the adult return from outplanted hatchery fry would be one quarter of what could be anticipated from an equal number of naturally produced wild fry (J. DeShazo, Washington Dept. Game, personal communication). Considering the large initial mortality on fry, the rearing mortality from surviving fry to smolt, and the poor smolt-to-adult survival rates for the 1979 and 1980 smolt outmigration (0.7 and 1.2, respectively), I believe that few adults returned to the SFSR to spawn as a result of the fry plants.

In 1980, approximately 246,000 smolts were stocked in the SFSR. In general, first generation returns from transplanted hatchery smolts are poor. First generation returns of Dworshak National Fish Hatchery smolts to the Pahsimeroi Hatchery as adults totaled 0.03%, the lowest smolt-to-adult return ratio experienced at the station (Reingold 1978). Smolts of the same stock as released at Pahsimeroi Hatchery with identical rearing histories were released at the Sawtooth facility for the first time in 1981. One- and two-ocean smolt-to-adult returns were nearly 50% less than return ratios observed at the Pahsimeroi facility (one-ocean: 0.58 to 1.01; two-ocean: 0.33 to 0.57) (K. Ball, IDFG, personal communication). Smolts released in the Little Salmon River in 1984 exhibited an extremely large percentage of residualism as evidenced by sport angler harvest after May 28. Consequently, data suggest that relatively few adults would be expected to return to the SFSR as a result of the first generation release of smolts in 1980. Data collected on mainstem spawning areas in 1983 (expected return of two-ocean adults which normally comprise 80% or more of Dworshak stock returns) support this premise. In the area immediately below the stocking location, personnel captured 17 hatchery steelhead, which comprised 30% of the fish sampled (Reid and Anderson 1984).

Hatchery steelhead that returned to the SFSR in 1983 presumably attempted to spawn with other hatchery fish or with wild adults. As Chilcote et al. (1982) observed in the Kalama River, Washington, hatchery steelhead spawn less successfully in the wild than wild fish. Hatchery adults and hatchery x wild pairings produced fewer smolts than pairing of wild adults. Other researchers have illustrated that indigenous, wild juveniles outperform juveniles of hatchery parentage (Reisenbichler and McIntyre 1977). As a result, relatively few hatchery parentage smolts may have been produced by the 1980 smolt stocking.

What is the permanent effect of the hatchery stocking in the SFSR? In order to have any effect, a large number of adult returns with good success In interbreeding with wild fish would be required over several generations. As Gall (in Lickatowich 1983) has observed, three genetic forces balance populations: 1) genetic drift, 2) migration, and 3) selection. If a large number of hatchery fish interbreed with wild fish in any one year, the effect will be balanced by the other two forces (especially selection) in subsequent generations. Consequently, if subsequent planting does not occur, selection will return the population to the original level of fitness. If a large number of adults do not return and interbreeding success is poor (as we expect in the SFSR), then the impact may not even be significant in the F1 generation. For these reasons, I consider the steelhead trout population in the SFSR to be an indigenous, wild stock that is unaltered by past hatchery stocking.

Future management of SFSR wild steelhead populations will require habitat restoration efforts, establishment of adequate escapement goals and accurate annual run size predictions. There are two methods to establish escapement objectives: 1) development of stock recruitment (S/R) curves based on measured escapement and adult recruitment, and 2) application of juvenile production data to available rearing habitat (Washington Department of Game 1983). Insufficient data are available to develop S/R curves for the SFSR drainage so juvenile production data collected in 1984 and 1985 will be applied to habitat measurements.

This methodology consists of calculating potential smolt production and back-calculating the number of adults required to produce that number of smolts as follows (Washington Department of Game 1983):

I. <u>Measurement of total steelhead rearing habitat at mid-summer flows</u>

Total accessible habitat surveyed in 1984 and 1985 was measured from aerial photos for the mainstem SFSR and 24 tributaries. Surface areas at mid-summer flows were calculated by applying mean widths of surveyed sections to lineal distances of similar habitat. Rearing habitat was expressed in 100 m^2 units.

Tributaries:

Total accessible km = 241.8 km
Surface area = 2,683,129 m^2
Rearing habitat = 26,831.3 units

Mainstem:

	Above the Secesh R.	Below the Secesh R.
Total accessible km =	83.8 km	58.7 km
Surface area =	1,361,880 m^2	1,958,330 m^2
Rearing habitat =	13,618.8 units	19,583.3 units

II. Application of steelhead production data to available habitat

Perhaps the best technique for assessing juvenile steelhead production is to quantitatively classify habitat into representative types and randomly sample abundance within each habitat. Slaney (1981) used six habitat classifications to estimate juvenile steelhead production in the Keogh River, British Columbia. Shepard (1983) classified habitats into six types in the Clearwater River drainage, Idaho. Within the SFSR, we selected sampling sites predominately within optimal "pocket-water" habitats. This sampling scheme was initiated for three reasons: 1) preliminary surveys indicated very small densities of steelhead, even within "optimal" habitat, 2) the project duration (2 years) and magnitude of the drainage, required a relatively rapid survey of individual streams, and 3) data were comparable to that collected in the Middle Fork Salmon River (Thurow 1985). As Shepard (1983) observed, a major drawback associated with sampling all habitat units is the time required to sample an entire stream.

Densities of juvenile steelhead within SFSR tributaries averaged 2.6 fish per 100 m^2 in 1984 and 1985. South Fork Salmon River tributaries could support larger densities of juvenile steelhead if habitat quality is improved and larger adult escapements occur. Other under-seeded Idaho streams exhibit densities similar to those we observed in the SFSR (Table 13). However, a large number of streams in the SFSR have degraded habitat so overall steelhead densities are small. A comparison with data from fully seeded streams suggest that current rearing densities in the SFSR may be a fraction of the potential carrying capacity (rearing densities of 10 to 20 fish per 100 m^2). Similarly, densities of 20 to 50 juvenile steelhead per 100 m^2 have been observed in some Clearwater River tributaries by Clearwater National Forest personnel. Densities of age-1 and older steelhead averaged 19 fish per 100 m^2 and 15 fish per 100 m^2 in Beaver and Skull creeks (tributaries to the North Fork Clearwater), respectively, in 1968 and 1969 (Cannon 1970).

Because we were not able to capture outmigrating smolts, potential smolt production must be estimated using data from other streams. Unfortunately, there are currently no detailed smolt yield data available for wild steelhead populations in Idaho. Most available information has been collected on coastal British Columbia and Washington streams. Smolt trapping studies on five streams illustrated production of 0.6 to 2.2 smolts per 100 m^2 (Marshall et al. 1980). Within Snow Creek, Washington, biologists recorded production levels of 3.1 smolts per 100 m^2 (T. Johnson, Washington Department of Game, personal communication). Data collected on interior streams suggest larger production rates. Bjornn (1978) observed production of 15.1 smolts per 100 m^2 in the Lemhi River, Idaho. Estimates of smolt production (based on density data rather than actual trapping) ranged from 6.2 to 11.6 smolts per 100 m^2 for three interior British Columbia streams (Marshall et al. 1980).

A relationship apparently exists between stream productivity, as expressed by total dissolved solids (TDS) and potential smolt production. The TDS of the mainstem SFSR is approximately 50 to 60 mg/I. Data plotted

Table 13. Steelhead parr densities observed in underseeded and fully seeded Idaho streams.

Stream	Density of age I+ older steelhead (fish per 100 m^2) Range	Mean	Author
Underseeded streams			
South Fork Salmon River tributaries	0.3 – 10.2	2.6	present study
Middle Fork Salmon River tributaries	0.2 – 10.5	4.0	Thurow (1985)
Mainstem Salmon River tributaries	9.8 – 14.5	–	Reingold (1981]
Selway River tributaries	5.7 – 17.2	–	Graham (1977)
Lochsa River triubtaries (upper sections)	8.5 – 10.0	–	Graham (1977)
Fully seeded streams			
Crooked Fork, tributary to Clearwater River	80– 100	–	Everest (1969)
Tributaries to South Fork Salmon River	–	40	Everest (1969)
Lochsa River tributaries (upper sections)	32– 77	51	Edmundson (1967)

for nine coastal and interior streams suggest smolt production of 3.0 to 4.0 smolts per 100 m^2 for streams with TDS of 60 to 80 mg/ l (Marshal I et al. 1980).

Another method of estimating smolt production is to evaluate the relationship between rearing juveniles and outmigrant smolts. Slaney (1981) estimated a smolt yield to summer parr density relationship of 0.4. Shepard (1983) that 40% of the 51 to 150 mm juvenile steelhead migrated as smolts. Thirty-six percent of the parr which migrated from Gobar Creek to Kalama River out-migrated as smolts the following year (Chiicote et al. 1984). If 30 to 40% of the summer parr in the SFSR outmigrate as smolts, and potential rearing densities equal 15 parr per 100 m^2 (range of 10 to 20), potential smolt production may range from three to six smolts per 100 m2.

I believe four smolts per 100 m^2 would be a reasonable potential production level for SFSR tributaries with restored habitat. Lick Creek, a stream with low embeddedness levels, supported 10.2 parr per 100 m^2 in 1985, which may equate to three to four smolts per 100 m^2. Smolt production potential from the mainstem SFSR may be somewhat less because observed rearing densities in the lower mainstem areas averaged 40% of those in tributaries (Table 5 and Appendix E.). Even with full seeding, it is unlikely the mainstem would produce as many smolts per unit area as tributaries because there is less usable habitat for steelhead in the mainstem. However, the lower mainstem SFSR does have proportionately more usable habitat for steelhead than the mainstem Middle Fork Salmon River due to its abundant boulder habitat and smaller discharge. Production of 1.5 smolts per 100 m^2 (40% of tributary production) may be a reasonable level for the mainstem SFSR below the Secesh River.

Potential smolt yield was calculated as follows:

Smolts from tributary areas and the upper mainstem.
(4 smolts/100 m^2 x 40,450.1 units) = 161,800 smolts

Smolts from mainstem areas below the Secesh River
(1.5 smolts/100 m^2 x 19,583.3 units) = 29,375 smolts

These calculations result in an estimated annual potential production of approximately 200,000 smolts.

Steelhead egg-to-smolt survival rates range from 0.5% to 2.5% for wild populations. Data from seven river systems in Idaho, Washington and British Columbia suggest that most egg-to-smolt survival rates are between 1 and 2 % (Bjornn 1978, Phillips et al. 1981, Washington Department of Game 1983). Consequently, I assumed a survival rate of 1% under poor spawning conditions (eg., poor quality spawning habitat, abnormal flows, abnormal temperature regimes, and redd superimposition), 1.5% under average conditions and 2% under optimal conditions in the SFSR. Although density dependent mortality likely affects egg-to-smolt survival (higher adult spawners = lower egg-to-smolt survival), the relationship is not well defined.

Adult steelhead returning to Idaho exhibit a larger proportion of females than males. Sixty-five percent of the wild steelhead trapped at the Lewiston Dam (N=2,364) from 1951 to 1957 were females (Keating and Murphy 1958). Wild steelhead trapped in the Lemhi River between 1969 and 1972 ranged from 63 to 81% females. Hatchery-reared steelhead returning to Dworshak National Fish Hatchery averaged 62% females from 1980 to 1984 (D. Diggs, USFWS, Fisheries Assistance Office, personal communication). Between 1980 and 1983, 59% of the hatchery steelhead returning to the Pahsimeroi Hatchery were females (Moore 1981 to 1984). I assumed a 60% female and 40% male proportion for SFSR wild steelhead population.

I applied egg-to-smolt survival rates of 1 to 2%, assumed a fecundity of 5,500 eggs per female (based on the large proportion of two- and three-ocean fish) and a sex ratio of 1.5 females per male in calculating escapement needs (Table 14). Depending on the spawning success, I estimated that a spawning escapement ranging from 3,000 to 6,000, with a mid-range of 4,000 fish, would produce 200,000 smolts.

The corresponding adult return rate from 200,000 smolts can be used to estimate when replacement of 4,000 adults will occur. At smolt-to-adult survival rates of 1%, replacement would not occur and the population would continue to deciine. At a survival rate exceeding 2.0%, replacement of 4,000 adult steelhead would occur. At survival rates approaching historical levels (4-5% in Raymond 1979), a surplus of several thousand steelhead would return to the SFSR drainage. These calculations illustrate that restoration of the SFSR steelhead population will be dependent both on measures to increase adult escapements and on habitat restoration in order to attain full smolt production potential.

Smolt production might also be enhanced by eliminating the harvest of steelhead parr. Current angling regulations allow harvest of steelhead parr, and anglers harvested more than 4,000 in 1985. If 40% of these parr ultimately migrate as smolts, 1,600 potential smolts were harvested. Further, we observed a significant decline in densities of age-II and Ill steelhead parr in the East Fork of the South Fork from 1984 to 1985. Since densities of age-I fish were similar, angler harvest may have influenced the decline. Restricting harvest of steelhead parr is consistent with statewide programs to rebuild wild stocks (Thurow 1985). A 200 mm size limit would protect 90% of the steelhead parr in tributaries and 81%,of the steelhead parr in mainstem areas.

Hatchery-reared rainbow trout are stocked annually in the East Fork of the South Fork and Johnson Creek. Current planting sites appear to be suitable to restrict movement of stocked trout into less accessible areas of the drainage. Anglers appear to target the stocked areas and returns of hatchery fish to the creel are large. A potentially negative impact of catchable trout releases is increased angling effort, which may result in increased harvest of depressed resident and anadromous wild trout populations.

Data collected in 1984 and 1985 further suggest that discrete populations of steelhead exist in the SFSR. That is, populations which spawn in specific locations, such as Lick Creek or Poverty Flat, have a low rate of genetic interchange. This premise is significant to considerations

Table 14. Required escapement to produce 200,000 smolts in the South Fork Salmon River drainage with varying egg-to-smolt survival rates.

Egg-to-smolt survival rate (%)	Required egg deposition (millions)	Required no. of females	Total escapement
1.0	20.0	7,000	6,000
1.5	13.3	2,400	4,000
2.0	10.0	1,800	3,000

for rebuilding of the populations. Although the overall steelhead population (sum of discrete populations) is viable and shows evidence of at least some rebuilding in recent years, certain discrete populations are at best "marginally" viable. Spawner surveys and parr density estimates illustrate that certain tributary populations (e.g., Buckhorn, Dollar, and Fitsum creeks) are in extremely low abundance and "marginally" viable. As noted in Forest Planning documents, any significant added source of mortality, such as sediment, could result in extinction of such a population (Anonymous 1985). For "marginally" viable populations, rebuilding is necessary to simply assure that these stocks remain viable for the future.

Even very small populations are extremely valuable and warrant rebuilding efforts. As Brannon (in Lichatowich 1983) observed, native stocks were generated by relatively few fish from original founding populations, so the fact that few numbers exist in present populations should not deter us from enhancement measures directed at rebuilding. Riggs (in Lichatowich 1983) further states that a large component of native, well-adapted genetic variation can be maintained in the progeny of five to ten individuals. Overlap in generations due to variation in age at spawning also ameliorates small population effects.

Although management for indigenous stocks is judged to be the most suitable goal for the SFSR drainage as Loftus (1981) states, attainment of the goal is likely to be a slow, deliberate and unspectacular process. The most significant measures to rebuild the SFSR wild steelhead stock include 1) restoration of habitat capabilities in the SFSR to assure improved egg-to-smolt survival, 2) management of commercial, Indian and sport fisheries in the Columbia River Basin to allow increasing escapements of wild steelhead adults, and 3) continued improvement in flow regime management and physical structures to increase smolt-to-adult passage in the lower Snake and Columbia rivers.

Harvest of SFSR steelhead in Idaho should be restricted until the stock is rebuilt. One alternative is to manage the stream as a non-consumptive fishery until a harvestable surplus is available. Catch-and-release fisheries regulations have been applied extensively to steelhead angling in Idaho. Mongillo (1984) provides a summary of data dealing with survival and reproductive success of summer steelhead that have been caught and released. No differences were found between hooked and unhooked fish. Additional data for winter steelhead suggests less than 10% mortality associated with bait fishing. Mongillo observed that this may be a worst case for winter steelhead since the fish were held in hatcheries as brood stock for up to five months.

At existing escapement levels in the SFSR system, a relatively small number of adults are distributed over a large area encompassing 24 drainages and 380 km of stream. In certain stream reaches it is feasible that only a few pairs of fish return. At these threshold population levels, even a slight degree of angling mortality is unacceptable. Consequently, catch-and-release fisheries in the SFSR should be postponed until existing escapements increase.

Data collected during this research can assist managers in eventually setting catch-and-release or consumptive seasons. Because few steelhead currently stage in the SFSR in fa l l , a fa l l season may not be warranted. Large numbers of fish do not ascend the drainage until March and April and most spawning has begun by mid-April, suggesting a March 1 to April 1 window for a fishing season. Because large numbers of steelhead stage in the lower 100 m of the SFSR where they are extremely vulnerable, managers may want to keep this area closed to avoid crowding of anglers and handling stress to fish. Further, steelhead spawn in most tributaries and in areas of the SFSR above its confluence with the East Fork of the South Fork. Consequently, the most suitable reach for a sport fishery would be on the mainstem SFSR from its confluence with the East Fork of the South Fork to the mainstem Salmon River.

Status of Resident Fish Species

Fish distribution and abundance surveys and creel census investigations indicate that the SFSR drainage currently supports a limited population of resident trout species. Steelhead parr comprise 93% of the age-I and older salmonids in the mainstem SFSR and 79% of the fish in tributaries. Steelhead parr and hatchery-reared rainbow trout comprise 81% of the overall angler harvest with the remainder comprised of bull, wild rainbow (>250 mm) and cutthroat trout.

Westslope Cutthroat Trout

Westslope cutthroat trout (cutthroat), in particular, appear to be in low abundance. Cutthroat comprised 3% of the age-I and older salmonids in the mainstem SFSR and 2% of the fish in tributaries. Similarly, cutthroat comprised 2% of the overall angler catch during the census period.

Our observations suggest that the SFSR drainage supports a small population of fluvial cutthroat with a life history similar to that Mallet (1963) described. Tributaries may function as primarily spawning and rearing areas for mature fish from the SFSR or mainstem Salmon River. Cutthroat displayed increased growth rates after age-Ill which reflects movement of fluvial stocks from tributaries to mainstem areas. Eighty percent of the cutthroat caught or observed in the mainstem SFSR exceeded 200 mm and fish ranged up to 360 mm. In contrast, 91% of the cutthroat caught in tributaries were less than 200 mm. It is likely that tributaries also support resident populations of cutthroat as Thurow (1985) observed in Middle Fork Salmon River tributaries.

To date, historical information on the former cutthroat trout population in the SFSR drainage has been scarce. However, interviews with individuals who have lived in the area since the 1920's suggest that cutthroat were formerly more abundant in the SFSR below the Secesh River, the East Fork of the South Fork, and Johnson Creek than they are today. Catches of 250 to 400 mm cutthroat were reported as being "common" and several photographs that I observed supported this. A few residents reported harvesting cutthroat up to 450 mm in areas of the East Fork of the South Fork and Johnson Creek in the 1920's and 1930's. As recently as the

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1960's, residents of the area hiked below the Secesh River to fish for large (>300 mm) cutthroat. The first biologists to work on the SFSR entered the area in the 1950's. They reported very few cutthroat in the stream at that time (D. Anderson, IDFG personal communication).

Although it seems inconceivable that the cutthroat trout population could have declined significantly by 1950, evidence suggests that decline did occur. Reasons for this suspected decline include 1) excessive angler harvest, 2) destruction of spawning and rearing habitat, and (3) mortality due to periodic toxic spills.

<u>Angler harvest.</u> Early human population growth was heavily influenced by mineral resource development in the vicinity of the SFSR drainage. Several large mining communities probably created a demand for fresh meat, including fish. The area received large influxes of people very early in Idaho's history. During the peak mining years from 1862 to 1869, the population of Warren ranged from 5,000 to 7,000 people (J. Fee, Payette National Forest, USDA-Forest Service, personal communication). Between 1870 and 1880, two commercial companies netted kokanee and sockeye salmon in the Payette Lakes (Evermann 1896). One company processed 75,000 fish in a single year. By 1880 fish were no longer plentiful enough to support a commercial venture. Trails were well established through most of the areas by the 1880's and precious metals were discovered at Thunder Mountain and on the East Fork of the South Fork in the early 1890's. The Thunder Mountain Road was built around 1900 and the town of Roosevelt (on Monumental Creek) contained 7,000 people in 1903 (Bailey 1978). During this era, fish were captured by any means available, including dynamite, spears, nets, rifles, by diverting streams and with hook-and-line.

Although early population centers such as Warren and Roosevelt followed a "boom" and "bust" scenario, other populated areas of the SFSR continued to grow. Population growth began at Stibnite in 1919 with formation of a mining company. During the 1930's, roads were completed and improved along the East Fork of the South Fork and the mainstem SFSR. The major growth at Stibnite occurred in the late 1930's and early 1940's during the wartime rush to increase antimony and tungsten production. By 1942, an estimated 2,000 people lived in Stibnite (Anonymous 1980). Yellowpine also remained a viable community. In addition, several homesteads were developed on the SFSR below the Secesh River, as evidenced by an 1879 census of nearly 40 people on the lower SFSR. The combination of large numbers of people and improved access undoubtedly impacted resident fish populations in the SFSR prior to 1950.

As Bjornn (1975) observed, fishery managers have witnessed the virtual elimination of westslope cutthroat populations in large Idaho river systems. Cutthroat are extremely vulnerable to angling and as access improves, populations may be nearly fished to extinction. Due to their late maturity (300 mm at age-V throughout most of their range), and as effort increases, a majority of the catch is generally comprised of younger-aged fish. Thus, fewer fish survive long enough to mature and spawn. Within the SFSR in 1984 and 1985, 77% of the cutthroat in the harvest were less than 300 mm. We were not able to calculate annual mortality rates of age-Ill and older cutthroat due to insufficient sample size. Behnke (1979) estimated that angling pressure of 50 hours per acre per year was sufficient to overexploit westslope cutthroat in a stream. Effort on the East Fork of the South Fork averaged 60 and 110 hours per acre per year in 1984 and 1985, respectively.

The impact of increased angling effort on westslope cutthroat has been well documented in other Idaho drainages with similarly low dissolved nutrients. These include Kelly Creek (Chapman et al. 1973), the St. Joe River (Johnson and Bjornn 1978), the Middle Fork Salmon River (Ortmann 1971), the Selway River (Lindland 1979), the Lochsa River (Lindland 1982) and the Coeur d'Alene River (Bowler 1974).

Habitat losses. Destruction of spawning and rearing habitat would act cumulatively with increased angler harvest to further reduce cutthroat populations. The impact of several decades of unregulated mining may have been severe. As an 1894 article in the Idaho County Free Press stated, "Where there is no mining the streams are alive with mountain trout." Placer mining was widespread and usually associated with perennial streams. A June 23, 1911 article in the Grangevillenewspaper reveals the enormous quantity of sediment generated by placer mining. An individual drowned near the Smith Ranch (currently Hettinger Ranch, 24 km above the Salmon River) on the lower SFSR. The Golden Rule Placer Company and Herbert Thorpe of the Secesh Placer (both in Secesh Meadows, approximately 71 km upstream) "ceased operations...in order to allow the water to become clear in the hope that the body could be seen...." The article further noted that the Golden Rule and Gott Mining Co. were running 10 giants (dredges) between them.

As mining accelerated at Stibnite, severe impacts occurred. Enormous quantities of sediment were deposited as streams were diverted and tailings piles eroded. Local residents reported that prior to 1930, the East Fork of the South Fork generally ran clear. During much of the 1940's and 1950's, the stream generally ran very turbid as a result of mining operations. As reported in the Environmental Impact Statement, physical alteration of the stream bed and channel, the poor condition of the tailing pond, and the general disturbance of land bordering the streams has caused water quality degradation in the drainage (Anonymous 1980). It was estimated that 160,000 cubic feet of material was deposited in Meadow Creek between 1952 and 1964 from the main tailings pile alone.

The construction of several hundred miles of access road adjacent to the SFSR, East Fork of the South Fork and Johnson Creek prior to 1930 may have also introduced quantities of sediment to the detriment of fish habitat.

The most visible loss of habitat occurred in the early 1960's as a result of extensive road construction and logging (Corley 1976). Several large tributaries and major sections of the mainstem SFSR remain heavily sedimented as a result.

Large quantities of interstitial fine sediment have a profound effect on spawning success of cutthroat trout. Of five species tested, cutthroat were the most sensitive to increased fine sediment and embryo survival declined sharply (Irving and Bjornn 1984). Data collected in the SFSR between 1983 and 1985 also illustrate that rearing populations of cutthroat may be sediment-limited (Fig. 23).

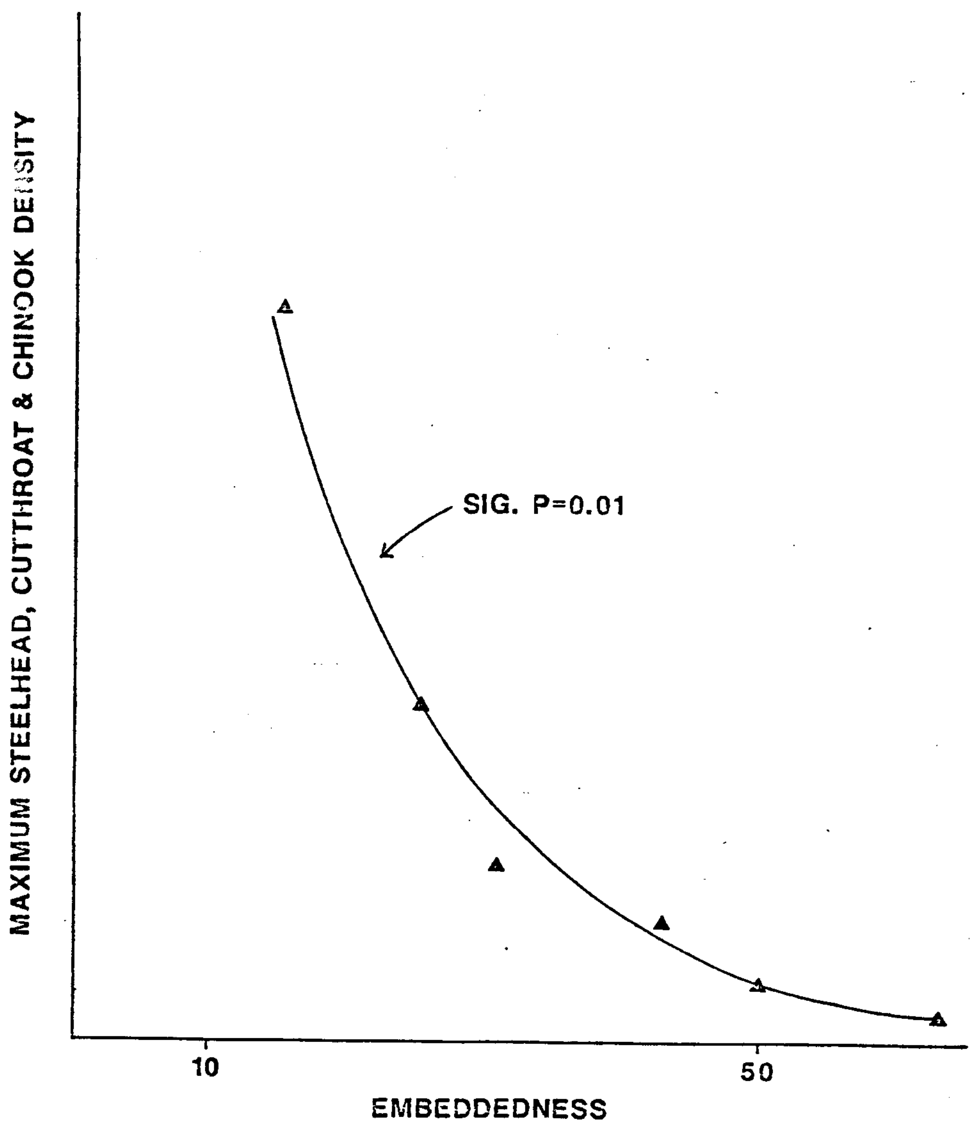

Figure 23. Embeddedness versus densities of steelhead parr, age-0 and age-1 chinook salmon and cutthroat trout sympatrically in the South Fork Salmon River and Chamberlain Creek.

Toxic spills. Periodic toxic spills occurred to the detriment of fish populations in the East Fork of the South Fork, Johnson Creek and the SFSR. Although records are incomplete, the following limited evidence suggests such spills occurred. Bailey (1978) reports that in the winter of 1932, an oil storage tank at Stibnite ruptured. No estimate of quantity lost is given although 12,000 gallons were flown in until the road was opened. In 1949, caustic soda was spilled into Johnson Creek. Local residents of the lower SFSR also reported seeing dead trout in the river in the 1930's and 1940's presumably as a result of toxic spills upriver. The impact of even a single, extensive fish kill on a cutthroat population under excessive harvest with poor recruitment could have been significant.

Heavy metal toxicity may have also caused fish losses. Mercury was mined by three companies on Sugar and Cinnebar creeks between 1921 and 1966. One company, Fern Quicksilver Mining, was the largest single producer of mercury in the U.S. during World War II (Anonymous 1980). Approximately 7,200 pounds of lead were recovered from the Yellow Pine Mine mill and smelter operation at Stibnite. Monitoring for arsenic, mercury and lead in fish flesh documented elevated concentrations of all three heavy metals in fish collected in the East Fork of the South Fork in 1978 and 1979 (Anonymous 1980).

In response to the low abundance of cutthroat in the SFSR, the IDFG will implement a drainage-wide catch-and-release regulation for cutthroat trout in 1986. Cutthroat have responded well to reduced angler harvest in the aforementioned drainages in Idaho (Kelly Creek and the St. Joe, Middle Fork Salmon, Selway, and Lochsa rivers). Because most spawning and rearing habitat is in poor condition, restoration may be required before significant responses in cutthroat numbers can occur.

Bull Trout

Bull trout are the most abundant resident game fish (with the exception of mountain whitefish) in the SFSR drainage. Both resident and fluvial stocks are present. Fluvial stocks provide a trophy fishery of 400 to 700 mm fish. We observed bull trout in all reaches of the mainstem SFSR and in 18 tributaries. Densities of bull trout tended to be larger in smaller, headwater sections of streams as Platts (1974) also observed. Our observations concur with Shepard et al. (1984a) who observed higher bull trout densities in colder stream reaches.

Densities of bull trout in the SFSR were similar to those observed by Thurow (1985) in the Middle Fork Salmon River. We observed 28 bull trout in 53 mainstem SFSR transects ($x = 0.03$ fish per 100 m^2) and Thurow observed 26 bull trout in 60 mainstem Middle Fork Salmon River transects ($x = 0.01$ fish per 100 m^2). Within tributaries, we observed 299 bull trout in 13 tributaries ($x = 0.51$ fish per 100 m^2) and Thurow observed 86 bull trout in 10 tributaries ($x = 0.26$ fish per 100 m^2). The range of 0.26 to 0.51 bull trout per 100 m^2 is also similar to densities observed in the Lochsa and Seaway rivers (Graham and Bjornn 1976).

We observed larger densities of bull trout in streams we electrofished (range of 0.34 to 11.42 fish per $100m^2$, x = 3.12 fish per 100 m^2) than in streams we snorkeled as Shepard et al. (1984a) also reported.

Tributaries function as spawning and rearing areas for fluvial bull trout. Most (90%) of the bull trout in tributaries were juvenile fish less than 200 mm. Bull trout displayed increased growth rates after age-Ill which reflects movements of fluvial stocks from tributaries to mainstem areas. Shepard et al. (1984a) reported that juvenile bull trout generally emigrated from tributaries during high spring and summer flows at ages-I to Ill with the smallest proportion at age-I. Although limited data are available, emigrating juvenile bull trout probably reside in sections of the mainstem SFSR and Salmon rivers. Bull trout are reported to become highly piscivorous and opportunistic. Shepard et al. (1984a) found that bull trout frequented areas of the Flathead River containing large densities of yearling whitefish, suggesting whitefish are an important food item.

Migration of adult bull trout probably begins in March or April as adults move slowly upriver and arrive near spawning areas in July. During March and April adult steelhead surveys, we normally began capturing adult bull trout at the same time (mid-March) we begin observing adult steelhead. Mallet (1963) reported that bull trout comprised the bulk of the spring catch (81% in March and 72% in April) of game fish in the mainstem Middle Fork Salmon River. Bull trout tagged by Mallet in the Middle Fork Salmon River migrated upstream in spring an average of 30 km. Movements ranged from 3.2 to 105 km. In the SFSR, most bull trout larger than 250 mm were caught by anglers in July and August. In 1984, 95% of the creeled bull trout were caught after July 14 and in 1985, 70% were caught after July 6.

Mature adults probably enter tributary streams from late July through September (Shepard et al. 1984a). We observed large (> 400 mm) bull trout staging in some SFSR tributaries in August and September. After spawning, adults may remain on spawning grounds for a brief time and migrate back to mainstem areas. Mallet (1963) observed that bull trout also comprised the bulk (55%) of the October game fish harvest in the Middle Fork Salmon River, presumably during downstream migration. Tagged bull trout moved downstream' in the fall or winter an average of 39 km (1.6 to 323 km). Shepard et al. (1984a) reported some evidence that spent adult bull trout in the Flathead River may feed on winter concentrations of mountain whitefish during their downstream migration.

Although the bull trout population in the SFSR is vi-able, additional data is necessary for management (Appendix A). The status of discrete populations is unknown, as is the impact of angler harvest. The perterbations which degraded spawning and rearing habitat for other resident and anadromous species also affected bull trout. These impacts are not entirely understood. Shepard et al. (1984b) attempted to document the impacts of fine sediment on spawning success and rearing populations of bull trout. At levels of fine sediment (less than 6.4 mm) above 30%, survival of bull trout embryos declined. Bull trout embryos were more tolerant of fine sediment than cutthroat trout or steelhead trout and survival appeared to be similar to that reported for chinook salmon embryos (Tappel and Bjornn 1983). Densities of rearing juvenile bull trout also declined sharply when more than 30% of the streambed was comprised of fine sediment. Consequently, measures to restore spawning and rearing habitat in the SFSR will also benefit bull trout populations.

Implications of Land Management Activities

While improvements in fish passage and management to increase survival have benefited the wild steelhead population in the SFSR drainage and regulations may be applied to benefit resident species, the habitat condition in the SFSR is a major factor influencing restoration of resident and anadromous fish populations. Although the quantity of sediment in the drainage has improved since the 1960›s (Megahan et al. 1980), a large quantity of interstitial fine sediment remains and most of the recovery has yet to occur (Burns 1984).

Road construction, removal of surface vegetation and disruption of unstable soil surfaces have been identified as the major types of man-caused disturbances which deposit fine sediment in Idaho Batholith streams (Anonymous 1980). Burns (1984) and Burns and Edwards (1985) observed a direct relationship between embeddedness and the degree of development. Undeveloped streams exhibited embeddedness from 19 to 30%, while developed streams exhibited embeddedness from 36 to more than 50%. Edwards and Burns (1986) found the embeddedness of fish habitat to be a function of road density and the acreage of roads currently at risk of mass wasting, combined with the amount of a drainage dominated by a glaciated Iandtype. The significant relationship between road development, or road density, and habitat condition agrees with previous studies (Cederholm et al. 1981, Shepard et al. 1984b, Stowell et al. 1983).

The detrimental effect of fine sediment on salmonid populations has been well documented. Sediment has been shown to affect spawning success (Cordone and Kelly 1961, Irving and Bjornn 1984, Shepard et al. 1984b, Stowell et al. 1983, Tappet and Bjornn 1983) as well as rearing capacity.

Empirical data we collected in the SFSR are in agreement with other research evaluating effects of sediment on fish populations. Based on redd capping experiments on the Poverty Flat spawning area, survival of steelhead embryos was affected by the levels of fine sediment (less than 6.33 mm). Since 1980 the levels of fine sediment in the Poverty Flat and Oxbow spawning areas have ranged from 29 to 36% (USDA-Forest Service 1985). At these levels, survival of steelhead fry to emergence is predicted to remain at 10% or less (Stowell et al. 1983). Empirical data we collected on the Poverty Flat spawning area indicated an average of 8% and 10% egg-to-emergent-fry survival in 1984 and 1985, respectively.

Within rearing habitats, a significant statistical relationship was observed between rearing densities of fish and embeddedness. Thurow and

Burns (1986) compared fish density measurements in 62 transects with embeddedness measurements in 27 stream reaches in the SFSR, 18 tributaries, and Chamberlain Creek (also an Idaho Batholith stream). A plot of maximum fish densities, paired with embeddedness measurements in 10% increments, resulted in a highly significant negative relationship ($p = .01$, $r = .99$) (Fig. 23). As the percentage of fine sediment increased, the densities of rearing salmonids decreased. The shape of the curve closely approximates the relationships observed by a series of other researchers (Bjornn et al. 1977, Kelly and Dettmann 1980, Reiser and Bjornn 1979, Shepard et al. 1984b).

This data suggest that sediment acts to limit populations of resident and anadromous salmonids in the SFSR by decreasing spawning success and reducing juvenile rearing capacity. Response of fish to sediment in rearing habitat may be caused by 1) reduction in summer rearing habitat (Bjornn et al. 1977), 2) reduction in winter rearing habitat, 3) reduction in aquatic invertebrate production, and 4) decreased spawning success. Burns (1984) observed a significant correlation between embeddedness levels and levels of fine sediment measured by core sampling in spawning areas.

The slope of the fish density versus embeddedness curve (Fig. 23) also illustrates that fish show an almost immediate response to increased sediment. Further, at embeddedness levels exceeding 30%, the asymptote of the curve is approached. Populations in habitat at or above 30% embeddedness are in jeopardy of elimination if additional impacts occur. The curve shape also illustrates that an expression of percent of fish production potential is not an acceptable standard to protect fish habitat. For example, if 60% of potential is a stated goal, this point is very close to the asymptote of the curve. Any additional impact could jeopardize the populations. Due to the exponential decay of the curve, it is necessary to establish standards precisely in terms of actual habitat conditions.

Consequently, streambed habitat monitoring (as embeddedness) should be part of any monitoring program to protect and restore fish habitat in the SFSR. Habitat-based measurements are useful in monitoring the impacts of proposed developments on fish habitat and in monitoring levels of improvement in degraded habitats where prescriptions have been applied. Resource managers may apply these relationships to develop standards and management strategies to restore habitat conditions in the SFSR.

Improvements in the habitat condition in the SFSR drainage will return large dividends for the resident and anadromous fish populations and ultimately for all citizens. A reduction in the percent fines from 30% to 20% would result in a predicted improved egg to emergent fry survival from less than 10% to nearly 80% (Stowell et al. 1983). The summer and winter rearing capacities of heavily embedded streams would also increase if levels of fine sediment were reduced (Bjornn et al. 1977). Alexander and Hansen (1983) similarly observed enhanced rearing habitat for trout as a result of reduced sand bedload. At the existing habitat condition, we estimated (based on drainage by drainage calculations) existing steelhead smolt production at 45,000. At full potential, smolt production would equal nearly 200,000.

A commitment, by land management agencies, is necessary to conduct activities in the SFSR drainage in a manner that will allow continued improvements in the fish habitat. The ultimate goal should be to restore the fish habitat from its present 55% of potential to nearly full potential. Without this commitment, the potential for fish production in the SFSR will not be realized and unique populations of wild steelhead, chinook salmon, cutthroat trout and bull trout could be eliminated.

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APPENDICES
A - T

Appendix A. A sampling program to monitor fish populations in the South Fork Salmon River

Baseline data collected in 1984 and 1985 can be compared to information collected in the future for the evaluation of resident and anadromous stocks. With a moderate amount of effort, managers may acquire necessary information. A suggested sampling program is listed and briefly discussed.

Wild steel head escapements

Sections of the SFSR and tributaries are conducive to accurate counts of steelhead redds during the spawning period. Commencing on approximately April 20, ground surveys may be completed every 5 days through May 20 or as long as visibility is suitable. It is advisable to sketch a rough map of each index area and mark newly constructed redds during each survey. This procedure prevents re-counting of redds between surveys. Counts should be conducted between 0900 and 1700 hours. Polaroid sunglasses, a visor, and binoculars assist in identifying redds.

Suggested index areas to be annually surveyed include: Poverty Flat, Darling Cabins, the Oxbow, Lick Creek (mouth to Cow Creek Bridge), and Johnson Creek (Ice Hole to Clements Ranch Bridge). These areas are displayed in Figures 5, 9 and 10.

Fish densities

Transects were established in the mainstem SFSR and 22 tributaries. Annual counts of fish in a selected number of transects may be used to 1) evaluate the response of cutthroat trout to catch-and-release regulations implemented in 1986, and 2) monitor the rebuilding of rearing populations of wild steelhead trout parr.

It is recommended that the following transects be surveyed in tributaries: a) East Fork of the South Fork, No. 3-10; b) Johnson Creek Lower, No. 1-3 and Spawn No. 1-3; c) Lick Creek Lower, No. 1-5; and d) Fitsum Creek Lower No. 1-5. Within the mainstem: transects No. 2, 5, 7, 11, 14, 16 and 17-28.

Observers should standardize counts by duplicating the procedure described for Rearing Densities of Fish (this report). In summary, where possible a single diver proceeds upstream and records the total number of game fish by species. Steelhead parr and cutthroat trout are classified by size groups. In larger water, two divers are used to replicate counts while floating downstream. In either case, the surface area snorkeled is measured and related to the number of fish counted. With the exception of age-0 chinook salmon, young-of-the-year are not counted. All counts should be made between July 10 and September 5 when fish populations are expected to be stable.

Bull trout surveys

An insufficient amount of information exists to manage bull trout in the SFSR drainage. Existing data document the presence of resident and fluvial stocks of bull trout and the distribution of the species in most of the drainage.

It is recommended that data be collected to determine age and length at maturity for fluvial bull trout. When possible, scales should be collected and analyzed from bull trout exceeding 300 mm. Due to the difficulty in reading scales on larger fish, otoliths should be collected from angler creeled fish. This data may be combined with the 100 bull trout aged in 1985 (Appendix R).

Principal bull trout spawning areas also need to be identified. Several East Fork of the South Fork tributaries (Profile, Tamarack, Sugar, Quartz) are believed to support fluvial spawning populations. Adults likely enter tributaries from early August through September and stage in pools prior to spawning. Northwest bull trout populations generally spawn between September 10 and October 30 (Shepard et al. 1984a). Spawning appears to be initiated by photoperiod, increasing streamflow (fall precipitati-on), and a decline in water temperatures below 9C. Shepard et al. (1984a) also reported that bull trout appear to select spawning areas in gravel and cobble: 1) influenced by groundwater recharge, 2) in low gradient areas at interfaces below high and low gradient channels and 3) where the stream splits into multiple channels. Several locations meeting these criteria are present in the aforementioned tributaries. Size of redds is obviously dependent on adult size, and other researchers have successfully counted bull trout redds. Shepard et al. (1984a) provide a bibliography of spawning behavior.

Within the aforementioned tributaries, biologists are urged to survey potential staging areas for adult bull trout between early August and mid-October. If feasible, a sample of mature adults should be collected via electrofishing or trapping for length-at-age information. Since bull trout are very prone to handling mortality, they should be handled minimally and with extreme care (B. Shepard, Montana Department of Fish, Wildlife and Parks, personal communication). When possible, potential spawning areas should be surveyed for adults and redds.

Expanded tributary surveys

We were incapable of surveying all tributaries with the potential- to support fish populations. It is recommended that periodic surveys be conducted to gather data regarding fish distribution and abundance in areas we did not assess.

Between July 10 and September 5, biologists may select sampling sections in representative habitats. Sections (minimum of 100 m each) should be selected to assess lower sections of drainages near their confluence with larger streams and upper headwater sections. Potential barriers should be noted and marked on topographic maps. Fish populations may be rapidly evaluated using a backpack electrofisher and a "two-pass" technique as described in Rearing Densities of Fish. Within inaccessible stream reaches, snorkeling may be substituted. All game fish should be recorded by species and sizes when feasible and the incidence of non-game species noted. Following the estimate of fish abundance, the total length and width of the sections should be recorded at systematic intervals to estimate the surface area surveyed. Finally, sampling sections may be photographed and a map drawn to enable biologists to resample the site in the future.

A partial list of unsurveyed streams and additional reaches to be surveyed in other streams includes (by area):

<u>SFSR</u> (Knox Bridge to Secesh River)	<u>SFSR</u> (Secesh River to Salmon River)
Phoebe Cr. (Meadow)	Sheep Cr. (headwaters)
Goat Cr.	Pony Cr.
Dollar Cr. (abv. North Fk)	Smith Cr.
Blackmare Cr. (headwaters)	Chicken Cr.
Buckhorn Bar Cr.	Rooster Cr.
Indian Cr.	Rattlesnake Cr.
	Porphyry Cr. (headwaters)
	Hamilton Cr.

<u>Johnson Creek.</u> (Below Trout Creek)	<u>Secesh River</u>
Ditch Cr.	Loon Cr.
Rustican Cr.	
Halfway Cr.	
Wardenhoff Cr.	

Appendix B. Physical dimensions and characteristics of snorkeling transects in the South Fork Salmon River, August 1984 and 1985.

Tran- sect	Location	River km	Date surveyed 1984	1885	Length (m) 1984	1985	Visibility (m) 1984	1985	Surface area Snorkled (m~) 1984	1985	Temperature (c) 1985	1984	Boulder	Substrate type (%) Rubble	Gravel	Sand	Silt
1	Cupps Corral	140	8/16	8/8	50	51	3.5 [a]	2.8 [a]	173	145	12.5	8.5	0	5	65	30	0
2	Silver King bridge	135	8/16	8/8	58	65	7.0 [a]	6.4 [a]	406	419	--	--	40	35	20	5	0
3	Mouth Rice Creek	130	8/16	8/8	52	52	8.8 [a]	8.2 [a]	462	427	15.0	--	0	20	35	40	5
4	Mouth Camp Creek	125	8/17	8/8	56	56	9.0 [a]	8.5 [a]	500	474	10.5	--	0	10	55	30	5
5	2nd bridge above Warm Lake road	120	8/17	8/8	51	47	9.5 [a]	10.1 [a]	486	475	--	--	5	45	35	15	0
6	Mouth Cabin Creek	115	8/17	8/8	64	48	14.9 [a]	14.3 [a]	1016	680	13.5	--	0	20	35	40	5
7	Mouth Dime Creek	110	8/17	8/9	63	63	10.2 [a]	9.1 [a]	649	574	15.5	9.5	75	15	5	5	0
8	Below Roaring Creek	105	---	8/9	--	69	--	12.7 [a]	--	881	--	--	5	64	30	1	0
9	Below Goat Creek	100	--	8/9	--	53	--	19.2 [a]	--	1015	--	--	45	30	10	15	0
10	Above Poverty Flat foot bridge	90	--	8/9	--	68	--	16.6 [a]	--	1137	--	--	60	15	5	20	0
11	Fourmile Creek	85	8/19	8/9	52	56	5.0	4.9	1040	1092	16.0	--	45	20	--	30	0
12	Start Oxbow spawn area	80	8/19	8/12	95	77	5.0	5.6	1840	1724	18.0	13.5	35	30	5	30	0
13	Road marker 22	75	8/19	8/12	103	105	5.4	5.6	2224	2352	--	--	15	25	0	60	0
14	Teepee Campground	70	8/19	8/12	79	90	5.4	5.6	1706	2016	--	--	10	20	5	60	5
15	Road marker 28	65	8/19	8/31	125	125	5.3	4.6	2650	1162	--	14.0	15	35	10	40	0
16	Below Fitsum Creek	60	8/19	8/22	108	110	5.3	6.0	2289	2662	18.5	--	40	40	5	15	0
17	Below Tailholt Creek	55	8/29	8/22	85	107	5.8	8.0	1972	2589	16.0	17.0	15	60	20	5	0
18	Mouth Sheep Creek	51	8/20	8/14	125	115	6.0	6.2	3000	2852	15:5	12.0	20	25	40	15	0
19	Mouth Reservoir Creek	46	8/21	8/14	150	120	6.0	8.2	3800	2876	13.0	--	45	35	10	10	0
20	Mouth Bear Creek 1	41	8/21	8/14	140	132	6.0	6.2	3360	3273	14.0	15.0	30	45	10	15	0
21	Below Elk Creek	37	8/22	8/15	140	122	5.5	6.6	3080	3220	12.5	15.0	40	50	5	5	0
22	Below South Fork guard station	32	8/22	8/15	82	85	6.4	6.6	2099	2244	15.0	16.0	0	30	30	40	0
23	Below China Creek	.27	8/22	8/16	110	100	6.4	7.6	2816	3040	15.0	14.5	--	--	--	--	--
24	Below Big Flat	23	8/23	8/16	118	118	6.8	7.6	3209	3587	15.0	17.0	25	45	20	10	0
25	Below Knob Creek	18	8/23	8/17	101	101	6.8	7.7	2747	3110	15.0	15.0	30	45	15	10	0
26	Mouth Rooster Creek	13	8/24	8/17	115	115	7.0	6.6	3220	3013	16.0	17.0	20	55	20	5	0
27	Below Raines Creek	8	8/24	8/18	100	100	7.0	6.1	2800	2440	16.0	15.0	40	50	5	5	0
28	Be Low Bad ley Ranch	4	8/25	8/18	102	109	6.3	6.1	2570	2659	16.0	17.0	--	--	--	--	--

[a]Total width.

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Appendix C. Fish species (other than steelhead] observed in South Fork Salmon River transacts, 1984.

Transect	Cutthroat trout (mm) <100	190–200	200–300	>300	Total	Bull trout (mm) <100	100–200	200–300	300–400	>400	Total	Chinook salmon Age 1	Adult	Mountain whitefish	YOY salmonids	Brook trout	Other
1	0	0	0	0	0	0	1	0	0	0	1	0	0	–	–	0	0
2	0	0	0	0	0	2	8	1	0	0	11	0	0	–	–	0	0
3	0	0	0	0	0	0	1	0	0	0	1	1	0	+	+	0	0
4	0	0	0	0	0	0	0	0	0	0	0	2	1	+	+	1	0
5	0	0	0	0	0	0	0	0	0	0	0	1	0	–	+	2	0
6	0	0	0	0	0	0	0	0	0	0	0	0	2	+	+	1	0
7	0	0	0	0	0	0	0	0	0	0	0	4	3	+	–	0	0
B						0	0	0	0	0	0						
9																	
10																	
11	0	0	0	0	0	0	1	1	0	0	2	0	0	+	+	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	1	+	–	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	5	+	+	0	0
14	0	0	0	0	0	0	0	1	0	0	1	0	0	+	+	0	0
15	0	0	0	0	0	0	0	0	0	0	0	2	0	+	+	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	+	–	0	sucker
17	0	0	0	0	0	0	0	0	0	0	0	0	0	+	–	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	+	–	0	0
19	0	0	0	0	0	0	0	0	1	0	1	0	0	+	–	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	+		0	0
21	0	0	1	0	1	0	0	0	0	0	0	1	0	+	+	0	0
22	0	0	4	1	5	0	0	0	0	0	0	0	0	+	–	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	+	–	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	+	–	0	squawfish
25	0	0	0	2	2	0	0	0	0	0	0	0	0	+	–	0	0
26	0	1	0	0	1	0	0	0	0	0	0	0	0	+	–	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	1	+	–	0	13
28	0	0	1	4	5	0	0	0	0	0	0	0	0	+	–	0	0
Total	0	1	6	7	14	2	11	3	1	0	17	11	13	+	+	4	

+present –
absent

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Appendix D. Fish species (other than steelhead) observed in South Fork Salmon River transacts, 1985.

Tran-sect	Cutthroat trout (mm) <100	100-200	200-300	>300	Total	Bull trout (mm) <100	100-200	200-300	300-400	>400	Total	Chinook salmon Age 1	Adult	Mountain whitefish (mm) <230	230-300	300-380	Total	YOY salmonids
1	0	0	0	0	0	0	1	0					0	0	0	0	0	
2	0	0	0	0	0	0	0	0					0	0	0	0	0	–
3	0	0	0	0	0	0	2	0					0	0	1	0	1	+
4	0	0	0	0	0	0	0	0					0	0	0	0	0	+
5	0	0	0	0	0	0	0	0					2	0	0	'0	0	+
6	0	0	0	0	0	0	0	0					0	0	0	0	0	+
7	0	0	0	0	0	0	0	0					5	4	7	2	13	
8	0	0	0	0	0	0	0	0					0	4	7	3	14	–
9	0	0	0	0	0	0	0	0					0	4	5	3	12	+
10	0	0	0	0	0	0	0	0					0	5	45	10	60	+
11	0	1	0	0	1	0	0	1					3	0	0	0	120	+
12	0	0	0	0	0	0	0	0					1	0	0	0	65	–
13	0	0	0	0	0	0	0	0					2	0	0	0	100	+
14	0	0	0	0	0	0	0	0					0	0	0	0	110	+
15	0	0	0	0	0	0	0	0					0	0	0	0	25	+
16	0	0	0	0	0	0	0	0					0	0	0	0	30	+
17	0	0	2	0	2	0	0	0					0	0	0	0	20	
18	0	0	0	0	0	0	0	0					0	5	0	11	16	
19	0	0	0	0	0	0	0	1					0	6	0	16	22	
20	0	0	0	0	0	0	0	0					0	6	0	24	30	
21	0	0	1	0	1	0	0	1					0	0	0	0	20	
22	0	1	0	0	1	0	0	0					0	0	0	0	20	
23	0	0	1	0	1	0	0	0					0	0	0	0	15	
24	0	1	1	0	2	0	0	0					0	0	0	0	20	
25	0	1	0	1	2	0	0	0					0	0	0	0	30	
26	1	1	0	0	2	0	0	0					0	0	0	0	11	+
27	0	0	0	0	0	0	0	0					1	0	0	0	8	
28	0	1	2	2	5	0	0	0					0	0	0	0	18	
Total	• 1	6	7	3	17	0	3	3	5	0	11	9	14	34	65	69	780	

+present
–absent

Appendix E. Numbers and densities of steethead parr and chinook salmon observed by snorkeling in South Fork Salmon River tributaries, July-August 1984 and 1985.

Tributary	Section	Number steelheed parr Age I	Age II	Age III	Total	Density (No. per 100 m^2) Age I	Age II	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density [No. per 100 m^2) Age 0
1984 Data													
Buckhorn Cr.	Lower	52	40	3	95	3.15	2.42	0.18	5.75	9	0	0	0.54
	Lower pool	6	7	2	15	13.00	15.17	4.33	32.50	0	0	0	0.00
		58	47	5	110	--	--	--	--	8	0	0	--
Burntlog Cr.	Lower	7	8	3	18	0.39	0.45	0.17	1.01	10	0	0	0.56
	Lower pool	0	0	0	0	0	0	0	0	6	0	0	3.40
	Upper	6	7	3	16	1.24	1.44	0.62	3.30	0	0	0	0.00
	Upper pool	1	3	0	4	1.84	5.53	0.00	7.37	0	0	0	0.00
		14	18	6	38	--	--	--	--	16	0	0	--
East Fork South Fork	1.	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	2.	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	3.	2	5	3	10	0.95	2.38	1.43	4.76	0	0	0	0.00
	4.	8	9	3	20	1.37	1.54	0.52	3.43	0	0	0	0.00
	5.	12	15	4	31	1.93	2.41	0.64	4.98	5	0	0	0.80
	6.	8	15	3	26	0.35	0.66	0.13	1.14	82	0	0	3.64
	7.	6	26	5	37	0.52	2.24	0.43	3.19	8	0	0	0.69
	8.	13	20	4	37	0.66	1.01	0.20	1.87	90	1	0	4.56
	9.	14	33	1	48	0.53	1.25	0.04	1.82	15	0	0	0.57
	10.	1	9	1	11	0.11	0.99	0.11	1.21	13	0	0	1.43
		64	132	24	220	--	--	-	X=2.10	213	1	0	--

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Appendix E. Continued.

Tributary	Section	Number steelhead parr Age I	Age II	Age III	Total	Density (No. per 100 m²) Age I	Age II	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density per 100 m² Age 0
1984 Data Continued													
Fitsum Cr.	Lower	55	40	10	105	3.55	2.58	0.64	6.77	2	0	0	0.12
	Lower pool	8	6	2	16	5.61	4.21	1.40	11.2	0	0	0	0.00
		63	46	12	121	--	--	--	--	2	0	0	--
Johnson Cr.	Lower	78	71	7	156	1.68	1.54	0.15	3.37	302	4	0	6.53
	Spawning	0	0	0	0	0.00	0.00	0.00	0.00	128	0	2	1.64
	Tyn	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	MD	14	5	0	19	0.48	0.17	0.00	0.65	0	0	0	0.00
	Run	4	8	0	12	0.13	0.26	0.00	0.39	0	0	0	0.00
	PWA	60	46	7	113	2.01	1.54	0.23	3.78	0	0	0	0.00
	PWB	52	44	3	99	1.72	1.46	0.09	3.27	0	0	0	0.00
		208	174	17	399	-	--	--	-	430	4	2	--
Lake Cr.	Lower	7	5	4	16	0.28	0.20	0.16	0.64	158	27	1	6.38
Lick Cr.	Lower	101	75	11	187	4.23	3.14	0.46	7.83	61	11	0	2.56
	Lower pool	4	13	2	19	7.34	23.87	3.67	34.88	0	2	0	0.00
		105	88	13	206	--	--	--	--	61	13	0	--
Porphyry Cr.	Lower	22	31	10	63	1.98	2.80	0.90	5.68	0	0	0	0.00
Raines Cr.	Lower	3	5	0	8	2.65	4.42	0.00	7.07	0	0	0	0.00

RDFS1970M

Appendix E. Continued.

Tributary	Section	Number steelhead parr Age I	Age II	Age III	Total	Density (No. per 100 m²) Age I	Age	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density (No. per 100 m²) Age 0
1984 Date Continued													
Secesh River	Meadow	7	8'	2	17	0.19	0.21	0.05	0.45	415	23	2	11.29
	Middle	38	75	13	126	1.04	2.07	0.35	3.46	103	4	0	2.84
		45	83	15	143	–	–	--	--	518	27	2	--
Sheep Cr.	Lower	36	21	6	63	6.00	3.50	1.00	10.50	0	0	0	0.00
	Lower pool	4	1	1	6	17.63	4.40	4.40	26.43	1	0	0	4.40
		40	22	7	69	--	--	--	--	1	0	0	--
GRAND TOTAL		565	519	89	1173	--	–	–		1408	72	5	--
(excluding East Fork South Fork)													
1985 Data													
Buckhorn Cr.	Upper	5	9	9	23	0.44	0.80	0.80	2.04	0	0	0	0.0
	W.Fk. Lower	46	36	9	91	4.37	3.42	0.85	8.64	84	0	0	7.98
	W.Fk. Lower pool	7	7	3	17	14.85	14.85	6.36	36.06	1	0	0	2.12
		58	52	21	131	--	--	--	--	85	0	0	--

Appendix E. Continued.

Tributary	Section	Number steelhead parr Age I	Age II	Age III		Density (No. per 100 m²) AgeI	Age II	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density (no. per 100 m²)
1985 Date Continued													
Burntlog	Lower	0	0	0	0	0.00	0.00	0.00	0.00	27	0	0	1.63
	Lower pool	0	0	0	0	0.00	0.00	0.00	0.00	12	0	0	8.68
	Lower BPA pool	0	0	0	0	0.00	0.00	0.00	0.00	5	0	0	
		0	0	0	0	--	--	--	--	44	0	0	--
Canton Cr.	Lower	32	20	3	5 5	3.69	2.31	0.35	6.35	0	0	0	0.00
East Fork South Fork	1.	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	2.	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	.3.	3	3	2	8	1.38	1.38	0.92	3.68	20	0	0	9.17
	4.	4	5	2	1	0.96	1.20	, 0.48	2.64	5	0	0	1.20
	5.	12	17	2	3	2.09	2.96	0.35	5.40	25	0	0	4.35
	6.	3	3	1	7	0.13	0.13	0.04	0.30	57	0	0	2.50
	7.	10	20	4	3	0.80	1.59	0.32	2.71	11	0	0	0.88
	8.	10	11	0	2	0.62	0.68	0.00	1.30	32	0	0	1.97
	9.	1	12	1	1	0.05	0.62	0.05	0.72	1	0	0	0.05
	10.	1	7	0	8	0.12	0.82	0.00	0.94	40	0	0	4.66
		44	78	12	13 4	--	--	--	--	191	0	0	--
Elk Cr.	Lower	39	46	30	11	2.01	2.37	1.55	5.93	0	0	0	0.00
	Upper	0	0	• 2	2	0.00	0.00	0.41	0.41	0	0	0	0.00
	W.Fk. Lower	0	1	0	1	0.00	0.10	0.00	0.10	0	0	0	0.00
		39	47	32	11	--	--	--	--	0	0	0	--

Appendix E. Continued.

Tributary	Section	Number steelhead parr Age I	Age II	Age III	Total	Density (No. per 100 m²) Age I	Age II	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density (No. per 100 m²) Age 0
<u>1985 Data Continued</u>													
Fitsum Cr.	Upper	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	N.Fk. Upper	8	11	2	21	0.70	0.97	0.17	1.84	0	0	0	0.00
		8	11	2	21	--	--	--	--	0	0	0	--
Johnson Cr.	Lower	50	86	6	144	1.20	2.07	0.19	3.46	69	2	2	1.66
	Spawning	0	0	0	0	0.00	0.00	0.00	0.00	280	0	2	4.46
		50	86	8	144 '	--	--	--	--	349	2	4	--
Lick Cr.	Lower	94	99	8	201	4.74	4.99	0.40	10.13	94	4	0	4.74
	Lower pool	8	7	0	15	15.78	13.81	0.00	29.60	12	4	0	23.68
		102	106	8	216	--	--	-	--	106	8	0	-
Profile Cr.	Lower	1	2	0	3	0.10	0.20	0.00	0.30	0	0	0	0.00
	Lower pool	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	Upper	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
	Upper pool	0	0	1	1	0.00	0.00	2.92	2.92	0	0	0	0.00
		1	2	1	4	-	-	--	--	0	0	0	--
Quartz Cr.	Lower	0	1	0	1	0.00	0.08	0.00	0.08	0	0	0	0.00

Appendix E. Continued.

Tributary	Section	Number steelhead parr Age I	Age II	Age III	Total	Density [No. per 100 m^2] Age I	Age II	Age III	Total	Chinook salmon Age 0	Age I	Adult	Density (po. Age 0
1985 Data Continued													
Riordan Cr.	Lower	62	56	8	126	6.58	5.95	0.85	13.38	0	0	0	0.00
Secesh R.	Meadow	2	8	3	13	0.05	0.21	0.07	0.33	495	'19	1	13.00
	Middle	37	59	10	106	1.02	1.63	0.27	2.92	90	19	3	1.94
		39	67	13	119	--	--	--	~	585	38	4	--
Summit Cr.	Lower	1	3	0	4	0.06	0.18	0.00	0.24	0	3	0	0.00
Tammarack Cr.	Lower	5	7	5	17	0.46	0.65	0.46	1.57	21	0	0	1.95
	Lower pool	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0.00
		5	7	5	17	--	--	--	–	21	0	0	--
GRAND TOTAL (excluding East Fork South Fork)		397	458	101	856	--	--	--	–	1381	51	8	--

R9FE100M

Appendix F. Estimated population size and fish densities in electrofishad tributaries of the South Fork Salmon River, 1984 and 1985.

Stream	Sac-tion	Date	Tran-sect length (m)	Surface are! (m)	Catch 1	Catch 2	Papule-Lion Esti-mate	95% confi-dance interval	No. steetheed parr Age I	Age II	Age III	Total	Cut-throat trout	Bull trout	Chinook salmon Age 0	Age I	Moun-twin white-fish	Other	Density (No. per 100 m²) Total steel-head trout	Total. cut-throat trout	Total bull trout	Age 0 chinook salmon
Beer Cr.	L1	9/5	117	374.4	(Qualitative estimate only)				5	7	1	13	2	0	0	0	0	0	3.47	0.53	0.00	0.00
Trapper Cr.	L1	9/5	90.5	458.8	(Qualitative estimate only)				3	2	0	5	0	1	0	0	0	0	1.09	0.00	0.22	0.00
Total 1984									B	8	1	18	2	1	0	0	0	0				
Beer Cr. III	LI	8/25	59	179	7	3	10	7-13	1	3	0	4	4	0	1	0	0	1 HRbt	2.23	2.23	0	0.56
	12	8/25	51	231	18	2	20	19-21	1	2	0	3	12	0	4	0	0	1 BK	1.30	5.19	0	1.73
	U1	8/30	52	222	No fish caught				0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bleckmere Cr.	LI	2/6	55	451 .	21	21	>42	-	14	2	0	16	0	1	25	0	YOY	0	3.55	0	0.22	5.54
Camp Cr.	L1	8/28	38	86	'37	15	60	47-73	4	1	0	5	0	1	52	0	0	2 8K	5.81	0	1.16	60.47
	L2	9/4	45	156	17	2	19	18-20	12	4	0	16	3	0	0	0	0	, 0	10.26	1.92	0	0
Cougar Cr.	L1	8/28	54	304	8	3	11	2-14	1	0	0	1	0	0	10	0	D	0	0.33	0	0	3.29
	L2	8/28	57	290	13	4	17	14-20	8	4	0	13	0	1	0	0	D	3 BK	4.48	0	0.34	0
Dollar Cr.	LI	9/6	41	224	9	2	11	9-13	4	4	2	10	0	0	0	0	0	1 BK	4.46	0	D	0
Phoebe Cr.	L1	9/4	53	131	30	14	53	36-70	6	1	0	7	D	0	46	0	YOY	YOY BK	5.34	0	D	35.11
	L2	9/4	47	95	32	2	34	33-35	26	3	1	30	3	0	0	0	0	1 Unk	31.58	3.16	0	0
Sugar Cr.	LI	9/5	56	325	7	1	B	7-9	0	2	1	3	0	3	D	0	0	2 HRbt	0.92	0	0.92	0
	U1	9/5	56	301	9	2	11	9-'13	0	0	0	0	0	11	0	0	0	0	0	0	3.65	0
	U2	9/5	49	276	17	2	19	16-20	0	0	0	0	0	19	0	0	0	0	0	0	6.88	0
Trapper Cr.	L1	8/25	50	247	4	2	6	3-9	2	1	1	4	0	2	0	0	0	0	1.62	0	3.61	0
	L2	6/26	54	300	13	1	14	13-15	5	3	0	8	0	4	2	0	0	0	2.67	0	1.33	0.67
	U1	8/30	41	192	9	4	14	9-19	0	0	D	0	0	14	0	0	0	0	0	0	7.29	0
	U2	8/30	57	254	20	7	29	23-35	0	0	0	0	0	29	0	0	0	0	0	0	11.42	0
Total 1985									85	30	5	120	22	85	140	0		3 HRbt 7 8K 1 GT				

Appendix G. Numbers and densities of resident game fish observed by snorkeling in South Fork Salmon River tributaries, July-August 1984 and 1985.

Tributary	Section	Cutthroat trout [mm] <100	100-200	200-300	>300	Total	Total per 100 m²	Bull trout (mm) <100	100-200	200-300	300-400	>400	Total	100 m	Mountain fish	YOY nid	Brook trout
1984 Data																	
Buckhorn Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0	0		+	+	0
	Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	-				0
		0	0	0	0	0		0	0	0	0	0	0		+	+	0
Burntlog Cr.	Lower	0	1	0	0	1	0.06	0	1	0	0	0	1	0.06	+	-	0
	Lower pool	0	1	0	0	1	0.57	0	2	0	0	0	2	1.13	-	-	0
	Upper	0	5	2	0	7	1.44	10	7	2	0	0	19	3.91	-	-	0
	Upper pool	0	0	0	0	0	0.00	0	1	1	0	0	2	3.69	-	-	0
		0	7	2	0	9		10	11	3	0	0	24		+		0
East Fork South Fork	1.	0	4	0	0	4	3.72	0	0	0	0	0	0	0.00		+	0
	2.	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	-		0
	3.	0	0	0	0	0	0.00	0	1	2	0	0	3	1.43	+	-	0
	4.	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	-	0
	5.	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
	6.	0	0	1	0	1	0.04	0	0	0	0	0	0	0.00	+	+	0
	7.	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
	8.	0	0	1	0	1	0.05	0	0	0	1	1	2	0.10	+	-	0
	9.	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0

Appendix G. Continued.

Tributary	Section	Cutthroat trout (mm) <100	100-200	200-300	>300	Total	Total per 100 m²	Bull trout (mm) <100	100-200	200-300	300-400	>400	Total	Total per 100 m²	Mountain white-fish	YOY salmo-nid	Brook trout
1984 Data (Continued)																	
East Fork South Fork	10.	0	0	1	0	1	0.11	0	0	0	0	0	0	0.00	+	+	0
		0	4	3	0	7		0	1	2	1	1	5		+	+	0
Fitsum Cr.	Lower		0	0	0	0	0.00	0	0	0	0		0	0.00	+	+	0
	Lower pool		0	0	0	0	0.00	0	0	0	0	0	0	0.00		+	0
		0	0	0	0	0		0	0	0	0	0	0		+	+	0
Johnson Cr.	Lower	0	0	1	1	2	0.04	0	0	0	2	0	2	0.04	+	+	0
	Spawning	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
	Tyn	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	-	+	50
	MD	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	-	+	136
	Run	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	-	+	26
	PWA	0	3	0	0	3	0.10	0	0	0	0	0	0	0.00	-	+	12
	PWB	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	1
		0	3	1	1	5			0	0	2	0	2		+	+	225
Lake Creek	Lower	0	0	0	0	0	0.00	0	8	3	0	4	15	0.61	+	+	42

Appendix G. Continued.

Tributary	Section	Cutthroat trout (mm) <100	100–200	200–300	>300	Total	Total per 100 m²	Bull trout (mm) <100	100–200	200–300	300–400	>400	Total	Total per 100 m²	Mountain whitefish	YOY salmonid	Brook trout
1984 Data (Continued)																	
Lick Creek	Lower	0	1	0	0	1	0.04	0	1	0	0	0	1	0.04	+	+	0
	Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	–	0
			1	0	0	1		0	1	0	0	0	1	+		+	0
Porphyry Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	–	+	0
Raines Cr.	Lower	3	2	0	0	5	4.42	0	0	0	0	0	0	0.00	–	+	0
Secesh R.	Meadow	0	0	0	0	0	0.00	0	1	2	0	0	3	0.08	+	–	14
	Middle	0	1 .	0	0	1	0.02	0	0	1	0	0	1	0.02	+	+	3
		0	1	0	0	1		0	1	3	0	0	4	+		+	17
Sheep Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	–	–	0
	Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	–	–	0
		0	0	0	0	0		0	0	0	0	0	0	–		–	0
Grand Total (excluding East Fork South Fork)		3	14	3	1	21	10	21		9	2	4	46	+		+	284

Appendix G. Continued.

		Cutthroat trout (mm)				Total		Bull trout (mm)					Total		Mountain white-	YOY salmo-	Brook trou
		100-	200-			per	2	100-	200-	300-			per				
1985 Data																	
Buckhorn Cr.	Upper	0	0	1	0	1	0.08	19	29	10	0	0	58	5.16		-	0
	W. F. Lower	3	2	0	0	5	0.47	0	0	0	0	0	0	0.00			0
	W.F. Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00		-	0
		3	2	1	0	6		19	29	10	0	0	58				0
Burntlog Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
	Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00		+	0
	Lower BPA pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
		0	0	0	0	0		0	0	0	0	0	0		+	+	0
Canton Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0		0.00	-	+	0
East Fork	1.	1	1	0	0	2	1.73	0	0	0	0	0	0	0.00	-	-	0
South Fork	2.	0	0	0	0	0	0.00	0	0	1	0	0	1	0.80	-	-	0
3.		0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	U
4.		0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	-	6
5.		0	0	0	0	0	0.00	0	1	0	0	0	1	0.17	+	+	0
6.		0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
7.		0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
B.		0	0	1	0	1	0.06	0	0	0	0	1	1	0.06	+	-	0
9.		0	0	0	0	0	0.00	0	0	0	0	1	1	0.05	+	-	0

Appendix G. Continued.

Tributary	Section	Cutthroat trout (mm) <100	100–200	200–300	>300	Total	Total per 100 m²	Bull trout [mm] <100	100–200	200–300	300–400	>400	Total	Total per 100 m²	Mountain white-fish	YOY salmo-nid	Brook trout
<u>1985 Data (Continued)</u>																	
East Fork South Fork	10.	0	1	1	0	2	0.23	0	0	0	0	0	0	0.00	+	–	0
		1	2	2	0	5		0	1	1	0	2	4		+	+	6 HR[a]
Elk Cr.	Lower	0	0	0	0	0	0.00	0	1	4	1	0	6	0.31	–	+	0
	Upper	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	–	–	0
	W.F. Lower	0	0	0	0	0	0.00	1	5	11	2	0	19	2.04	–	–	0
		0	0	0	0	0		1	6	15	3	0	25		–	+	0
Fitsum Cr.	Upper	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	–	–	0
	N.F. Upper	0	0	0	0	0	0.00	1	11	6	0	0	18	1.58	–	+	0
		0	0	0	0	0		1	11	6	0	0	16		–	+	0
Johnson Cr.	Lower	0	1	1	0	2	0.05	0	0	0	1	0	1	0,02	+	+	3 HR[a]
	Spawning	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	+	0
		0	1	1	0	2		0	0	0	1	0	1		+	+	3 HR[a]

Tributary	Section	Cutthroat trout (mm) <100	100–200	200–300	>300	Total	Total per 100 m²	Bull trout (mm) <100	100–200	200–300	300–400	>400	Total	Total per 100 m²	Mountain white-fish	YOY salmo-nid	Brook trout
<u>1985 Data Continued</u>																	
Lick Cr.	Lower	0	1	0	0	1	0.05	0	0	1	0	0	1	0.05	+	+	0
	Lower pool	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	+	0
		0	1	0	0	1		0	0	1	0	0	1		+	+	0
Profile Cr.	Lower	0	1	0	0	1	0.10	0	1	23	7	3	34	3.41	+	–	0
	Lower pool	0	0	0	0	0	0.00	2	5	0	0	0	7	6.26	–		0
	Upper	0	6	5	0	11	1.40	10	17	7	2	0	36	4.57	–	–	0
	Upper pool	0	1	0	0	1	2.29	0	1	2	0	0	3	8.78			0
		0	8	5	0	13		12	24	32	9	3	80		+		0
Quartz Cr.	Lower	0	0	0	0	0	0.00	2	12	19	8	0	41	3.68	–	–	0
Riordan Cr.	Lower	0	0	0	0	0	0.00	0	0	1	0	0	1	0.10		+	0
Secesh R.	Meadow	0	0	0	0	0	0.00	0	1	1	0	0	2	0.05	+	+	9 BK[b]
	Middle	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	–	1 BK[b]
		0	0	0	0	0		0	1	1	0	0	2		+	+	10 BK[b]

Appendix G. Continued.

Tributary	Section	Cutthroat trout (mm) <10	100–200	200–300	>300	Total	Total per 100 m^2	Bull trout (mm) <10	100–200	200–300	300–400	>400	Total	Total per 100 m^2	Mountain whitefish	YOY salmonid	Brook trout
1985 Data Continued																	
Summit Cr.	Lower	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	+	—	B0 BK[b]
Tamarack Cr.	Lower	0	0	0	0	0	0.00	14	13	3	0	1	31	2.88	+	—	1 HR[a]
	Lower pool	0	0	0	0	0	0.00	0	1	0	0	0	1	1.63	—	—	0
		0	0	0	0	0		14	14	3	0	1	32	+		—	1 HR[a]
Grand Total (excluding East Fork South Fork)		3	12	8	0	23		49	97	88	21	4	259	+		+	90 BK[b] 4 HR[a]

[a]HR = hatchery rainbow trout.
[b]BK = brook trout.

Appendix H. Physical dimensions and characteristics of snorkeling transacts in the East Fork South Fork Salmon River, August 1984 and 1985.

Tran-sect	Location	Date surveyed 1984	Date surveyed L985	Length 1984	Length 198	Visibility (m) 1984	Visibility (m) 1985	Surface area snorkeled (m) 1984	Surface area snorkeled (m) 1985	Temperature (cJ 1984	Temperature (cJ 1985	Substrate type (%J Boulder	Rubble	Gravel	Sand	Silt
1	Mouth Fern Cr.	8/27	8/23	28	29	3.8	4.0	107.5	115.9	10.0	8.0	5	25	60	10	0
2	Mouth Fiddle Cr.	8/27	8/23	23	22	6.2	5.6	140.1	125.6	13.0	-	40	40	15	5	0
3	1.5 km above Tamarack Cr.	8/27	8/23	33	35	6.3	6.2	209.8	218.1	13.0	-	15	20	45	20	0
4	0.6 km below Profile Cr.	8/27	8/23	42	35	14.0	13.6	582.4	471.4	13.0	_	40	50	10	0	0
5	Mouth Quartz Cr.	8/29	8/23	58	59	10.8	9.8	623.3	575.1	9.0	14.0	35	50	10	5	0
6	Mouth Parks Cr.	8/29	8/26	115	115	19.6	19.8	2254.0	2280.8	10.0	14.5	20	55	15	10	0
7	Mouth Caton Cr.	8/29	8/22	59	65	19.7	19.3	1162.0	1256.7	-	11.0	60	35	5	0	0
8	0.5 km above Deadmen Cr.	8/29	8/22	70	70	9.4	23.2	1974.0	1621.7	12.0	--	30	40	20	10	0
9	0.2 km above Telephone Cr.	8/29	8/22	123	95	21.5	20.3	2644.0	1931.7	13.0	-	35	55	10	0	0
10	0.6 km below Williams Cr.	• 6/29	8/22	52	50	17.5	17.2	910.0	858.3	14.0	15.0	30	50	15	5	0

Appendix I. Mean dimensions of snorkeling transacts and electrofishing sections in South Fork Salmon River tributary sections, 1984.

Stream	Section	Date	Temperature ranbe (C)	Transect measurements (m) Length	Mean width	Surface area	Mean thalweg depth	% substrate type Boulder	Rubble	Gravel	Sand	Silt
Bear Cr.	Lower-EF	5 September	10.0	117.0	3.2	374.4						
Buckhorn Cr.	Lower	31 July		39.3	8.3	330.2	0.52	16	57	9	18	0
	Lower Pool	31 July		9.1	5.1	48.1	0.92					
Burntlog Cr.	Lower	24 July	11.0 to 13.5	36.7	9.7	357.7	0.59	21	50	25	4	0
	Lower Pool	24 July		20.5	8.6	176.3	0.63	0	10	80	10	0
	Upper	11 August	11.5 to 13.5	19.8	4.9	97.1	0.42	3	20	57	18	2
	Upper Pool	11 August		5.0	10.8	54.2	0.50	0	0	50	50	0
Fitsum Cr.	Lower	10 August	12.0	40.2	7.6	309.8	0.47	30	45	10	15	0
	Lower Pool	10 August		19.5	7.3	142.4	0.57	45	15	40	0	0
Johnson Cr.	Lower	27 July	12.5 to 15.0	76.0	20.2	1540.1	1.27	28	62	10	0	0
	Spawn	26 July	13.0 to 14.0	97.5	26.3	2600.5	1.05	2	25	53	20	0
	Tyndall	25-27 July [a]		91.4	4.7	426.6						
	Meadow	25-27 July [a]		121.9	7.6	961.5						
	Run	25-27 July [a]		77.2	13.9	1023.0						
	PWA	25-27 July [a]		69.5	13.6	993.5						
	PWB	25-27 July [a]		80.2	13.5	1004.0						
Lick Cr.	Lower	30 July	12.0	42.6	11.2	477.0	0.66	30	48	12	10	0
	Lower Pool	30 July		9.9	5.5	54.4	0.73	10	60	10	20	0
Porphyry Cr.	Lower	23 August	12.0	13.9	6.9	221.4	0.67	28	52	18	2	0

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Appendix I. Continued.

Stream	Section	Date	Temperature range (C]	Transact measurements (m) Length	Mean width	Surface area	Mean thalweg depth	% substrate type Boulder	Rubble	Gravel	Sand	Silt
Raines Cr.	Lower	25 August		6.3	3.7	22.6	0.86					
Secesh River	Meadow	6 August	12.0 to 16.0	78.4	15.7	1225.1	0.82	5	33	52	8	2
	Middle	7 August	11.5 to. 14.5	80.0	15.7	1207.3	1.10	34	50	8	8	0
	Lake Cr.	4 August	12.0 to 14.0	41.4	8.5	353.4	0.62	4	32	45	19	0
Sheep Cr.	Lower	20 August	13.5	21.4	5.6	119.9	0.46	32	56	6	4	0
	Lower Pool	20 August		8.1	2.8	22.68	0.64	50	40	5	5	0
Trapper Cr.	Lower-EF	5 September		90.6	5.1	458.8						

[a]Data collected by Petrosky and Holubetz (1985).
EF_ electrofishing section.

Appendix J. Mean dimensions of snorkeling transects and electrofishing sections in South Fork Salmon River tributary sections, 1985.

Stream	Section	Date	Temperature range (c)	Transect measurements (m) Length	Width	Surface area (m^2)	Thalweg depth	Substrate type (%) Boulder	Rubble	Gravel	Send	Slit
Bear Cr.	Lower-EF	8/25	10.5	55.6	3.8	205.1	0.28	30	58	10	2	0
	Upper-EF	8/30	7.0	52.5	4.2	222.2	0.38	5	50	35	10	0
Blackmare Cr.	Lower-EF	9/6	10.0	55.1	8.2	450.9	0.48	20	60	0	15	5
Buckhorn Cr.	Upper	7/23	12.0-19.5	35.8	8.2	224.4	0.39	13	42	35	10	0
	W.Fk. Lower	7/13	12.0-16.0	32.7	6.4	210.5	0.52	35	49	10	6	0
	W.Fk. Lower pool	7/13	-	6.2	7.6	47.1	0.80	10	30	50	10	0
Burntlog Cr.	Lower	7/25	9.0-18.0	38.0	8.8	330.8	0.48	21	50	25	4	0
	Lower pool	7/25		18.1	7.2	138.2	0.55	0	10	80	10	0
Camp Cr.	Lower-EF	8/28	13.0-15.0	41.5	2.9	121.1	0.23	20	23	22	35	0
Caton Cr.	Lower	8/29	10.5	34.8	5.1	173.4	0.49	34	36	24	6	0
Cougar Cr.	Lower-EF	8/28	11.5	55.5	5.4	296.7	0.36	5	48	17	30	0
Dollar Cr.	Lower-EF	9/6	9.5	41.1	5.5	224.4	0.28	10	80	0	10	0
Elk Cr.	Lower	8/6	11.5	85.5	7.7	648.5	0.58	27	62	10	1	0
	Upper	8/6-7	10.0-11.5	41.1	3.8	161.6	0.43	17	48	25	10	0
	W.Fk. Lower	8/7	8.5-11.5	35.4	5.3	186.2	0.52	30	48	24	0	0
Fitsum Cr.	Upper	7/19	18.5-17.0	27.5	4.5	124.6	0.38	14	36	28	24	0
	N.Fk. Upper	7/20	9.5-14.5	34.1	6.7	226.8	0.50	27	53	11	9	0
Johnson Cr.	Lower	7/24	12.0-14.5	81.3	17.0	1384.8	0.91	28	62	10	0	0
	Spawn	7/24	18.0-20.0	91.5	22.8	2091.7	0.94	2	23	48	25	2

Appendix J. Continued.

Stream	Section	Date	Temperature range (c)	Transect measurements (m) Length	Width	Surface area (m^2)	Thalweg depth	Substrate type (%) Boulder	Rubble	Gravel	Sand	Silt
Lick Cr.	Lower	7/26	12.0-15.0	41.4	9.6	396.1	0.53	30	48	12	10	0
	Lower pool	7/26	-	9.1	5.6	50.7	0.62	10	60	10	20	0
Phoebe Cr.	Lower-EF	9/4	13.5-14.0	50.1	2.2	113.0	0.17	10	21	13	46	10
Profile Cr.	Lower	7/10-12	11.0-14.0	31.4	6.3	199.4	0.58	33	56	11	0	0
	Lower pool	7/11	-	14.5	7.7	111.6	0.67	0	5	65	30	0
	Upper	7/11	11.0-11.5	29.4	5.4	157.6	0.45	19	68	13	0	0
	Upper pool	7/11	-	6.5	5.2	34.1	0.52	10	59	30	1	0
Quartz Cr.	Lower	8/3	9.0-13.0	32.8	6.8	222.7	0.56	42	47	11	0	0
Riordan Cr.	Lower	8/4	11.5-15.0	32.7	5.8	188.2	0.54	18	50	17	3	2
Secesh R.	Meadow	7/16	15.5-18.5	85.0	15.1	1269.0	0.72	0	48	27	9	6
	Middle	7/17	15.5-19.0	88.9	14.0	1200.1	1.02	47	40	13	0	0
Sugar Cr.	Lower-EF	9/5	-	55.9	5.8	325.0	0.33	5	25	60	10	0
	Upper-EF	9/5	8.5	52.6	5.5	288.4	0.30	5	35	47	13	0
Summit Cr.	Lower	7/18	11.0-14.0	39.5	8.2	322.3	0.72	2	5	53	7	0
										(33 vegetation)		
Tamarack Cr.	Lower	7/12	9.0-14.0	35.2	6.0	214.6	0.49	23	65	12	0	0
	Lower pool.	7/12	-	10.8	5.6	61.0	0.38	10	75	15	0	0
Trapper Cr.	Lower-EF	8/25-26	9.0	51.8	5.3	273.2	0.48	25	60	15	0	0
	Upper-EF	8/30	10.5	49.1	4.6	223.0	0.50	3	25	50	22	0

EF= electrofishing section.

Appendix K. Numbers of fish sampled by hook-end-line in South Fork Salmon River tributaries, July-September 1984 and 1985.

Date	Section	Steelhead parr	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	Hatchery rainbow	Total game fish
		FISH CAPTURED							
1984 Data									
Bear Creek II									
21 August	Lower	12	0	0	0	0	0	0	12
21 August	Upper-above 2nd barrier	8	0	0	0	0	0	0	8
	Totals	20	0	0	0	0	0	0	20
Bear Creek III (tributary to Johnson Creek)									
5 September	Lower	13	2	0	0	0	0	0	15
Blackmare Creek									
1 August	Lower	15	0	0	0	0	0	0	15
Buckhorn Creek									
3 July	Middle	2	0	10	0	0	0	0	12
31 July	Lower	31	0	0	0	0	0	0	31
	Totals	33	0	10	0	0	0	0	43

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Appendix K. Continued.

Date	Section	Steelhead parr	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	Hatchery rainbow	Total game fish
		FISH CAPTURED							
1984 Data (Cont.)									
Burntlog Creek									
19 July	Lower	17	3	2	0	2	0	0	24
24 July	Lower	7	0	0	0	0	1	0	8
11 August	Upper	25	20	5	0	0	0	0	50
	Totals	49	23	7	0	2	1	0	82
Dollar Creek									
18 July	Lower	22	4	0	0	0	0	0	28
Fitsum Creek									
4 July	North Fork	8	0	0	0	0	0	0	8
4 July	Lower	13	2	0	0	0	0	0	15
4 July	Middle (NFK to steep area]	12	0	0	0	0	0	0	12
18 July	North Fork	49	1	0	0	0	0	0	50
10 August	Lower	4	0	0	0	0	0	0	4
	Totals	86	3	0	0	0	0	0	89
Johnson Creek									
25 July	Above Landmark	7	0	0	0	0	6	0	13

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Appendix K. Continued.

Date	Section	Steelhead parr	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	Hatchery rainbow	Total game fish
		FISH CAPTURED							
1984 Data (Cont.)									
Johnson Cr. cont.									
25 July	Below Landmark	19	1	0	0	0	0	0	20
7 September	Lower	0	1	0	0	1	0	0	2
	Totals	26	2	0	0	1	6	0	35
Lake Creek									
4 August	Lower	0	0	0	0	2	5	0	7
Lick Creek									
11 July	Lower	68	0	0	0	4	0	0	72
28 July	Lower	9	0	0	0	0	0	0	9
30 July	Lower	36	0	0	0	0	0	0	36
6 September	Lower (electrofish)	67	0	2	0	0	0	0	69
7 September	Lower (electrofish)	43	0	0	0	4	0	0	47
	Totals	223	0	2	0	B	0	0	233
Porphyry Creek									
23 August	Lower	5	0	0	0	0	0	0	5

Appendix K. Continued.

		FISH CAPTURED							
Date	Section	Steelhead parr	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	rainbow	Total game fish
1984 Data (Cont.)									
Profile Creek									
10 July	Lower	2	4	21	0	0	0	0	27
Quartz Creek									
20 August	Lower	0	0	20	0	0	0	0	20
Riordan Creek									
20 July	Lower	25	0	0	0	0	0	0	25
Secesh River									
5 August	Upper	11	0	0	0	0	1	0	12
6 August	Middle (4.8 km below Summit Creek)	12	0	0	0	0	0	1	13
6 August	Upper	14	0	0	0	0	3	5	22
7 August	Middle (Chinook C.G.)	3	0	0	0	2	0	0	5
7 August	Lower	19	0	0	0	0	D	0	19
8 August	Lower	28	0	0	0	3	2	0	33
6 September	Upper	15	0	1	1	11	5	0	33
	Totals	102	0	1	1	16	11	6	137

Appendix K. Continued.

Date	Section	Steelhead parr	Cutthroat trout	Bull trout	Mountain whitefish	Chinook	Brook trout	Hatchery rainbow	Total game fish
		FISH CAPTURED							
1884 Data (Cont.)									
Sheep Creek									
20 August	Lower	15	0	0	0	0	0	0	15
Tamarack Creek									
17 July	Lower	15	2	2	0	0	0	0	19
Trapper Creek									
20 July	Lower	0	0	7	0	0	0	0	7
21 August	Lower	0	0	34	0	0	0	0	34
5 September	Lower	5	0	1	0	0	0	0	6
	Totals	5	0	42	0	0	0	0	47
	Grand Total	656	40	105	1	29	23	6	660

Appendix K. (Continued]

Date	Section	Steelhead parr	Rainbow trout	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	Hatchery rainbow	Total game fish
1985 Data										
Buckhorn Cr.										
23 July	Main upper	12	0	0	15	0	0	0	0	27
13 July	West Fork lower	8	0	0	1	0	0	0	0	9
13 July	West Fork upper	37	0	0	0	0	0	0	0	37
	Totals	45	0	0	1	0	0	0	0	46
Burntlog Cr.										
25 July	Lower	3	0	0	0	2	0	0	0	5
Caton Cr.										
29 August	Lower	31	0	0	0	0	0	0	0	31
Elk Cr.										
6 August	Main	55	1	0	0	0		0	0	56
7 August	West Fork	1	0	0	8	0	0	0	0	9
	Totals	56	1	0	8	0	0	0	0	65

Appendix K . Continued.

Date	Section	Steelhead parr	Rainbow trout	Cutthroat trout	Bull trou	Mountain whitefish	Chinoo k	Brook trout	Hatcher y	Total game fish
1985 Data Cont.										
Fitsum Cr.										
19 July	North Fork	9	0	0	2	0	0	0	0	11
Johnson Cr.[a]										
24 July, 24, 26 August	Lower	79	0	0	0	2	7	0	5	93
Lick Cr.										
26 July	Lower	58	0	0	1	0	2	0•	0	61
Profile Cr.										
10, 11 July	Lower	11	1	2	27	0	0	0	0	41
10, 11 July	Upper	0	0	15	27	0	0	0	0	42
	Totals	11	1	17	54	0	0	0	0	83
Quartz Cr.										
3 August	Lower	0	1	0	20	0	0	0	0	21
Riordan Cr.										
4 July	Lower	68	0	0	0	0	0	0	0	68

Appendix K. Continued.

Date	Section	Steelhead parr	Rainbow trout	Cutthroat trout	Bull trout	Mountain whitefish	Chinook salmon	Brook trout	Hatchery rainbow	Total game fish
1985 Data Cont.										
Secesh R.										
16 July	Middle	80	0	0	0	0	6	0	0	86
17 July	Upper	26	2	0	0	0	13	1	0	42
	Totals	106	2	0	0	0	19	1	0	128
Summit Cr.										
18 July	Lower	5	0	0	0	0	0	13	0	18
Tamarack Cr.										
12, 30 July	Lower	24	1	0	15	0	0	0	1	41
	GRAND TOTAL	507	6	17	116	4	28	14	6	698

[a]Count as hook and line.

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Appendix L. Fish observed by snorkeling in individual transects in South Fork Salmon River tributaries, July—August 1984 and 1985.

Stream	Transact	Fish observed Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Brook Trout	Surface area (m^2)	Steelhead per $100m^2$
1984 Data								
Bear Cr. II	LI	13	2	0	0	0	374.4	3.47
Buckhorn Cr.	LI	16	0	0	1	0	524.16	3.05
	L2	18	0	0	8	0	305.54	5.89
	L3	17	0	0	0	0	215.74	7.87
	L4	24	0	0	0	0	357.44	6.71
	L5	20	0	0	0	0	248.08	8.06
Totals		95	0	0	9	0	1650.69	
	LP	15	0	0	0	0	46.14	32.51
Burntlog Cr.	LI	1	0	0	0	0	497.08	0.20
	L2	3	0	0	4	0	280.00	1.07
	L3	5	0	0	0	0	333.38	1.49
	L4	6	1	1	6	0	289.80	2.07
	L5	3	0	0	0	0	388.08	0.77
Totals		18	1	1	10	0	1788.34	
	LP	0	1	2	6	0	176.30	0.00

Appendix L. Continued.

Stream	Transect	Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Brook Trout	Surface area (m^2)	Steelhead per $100m^2$
		Fish observed						
<u>1984 Data Continued</u>								
Burntlog Cr.	U1	4	0	3	0	0	96.46	4.14
	U2	4	2	5	0	0	114.95	3.47
	U3	4	3	4	0	0	88.24	4.53
	U4	2	1	3	0	0	109.09	1.83
	U5	2	1	4	0	0	76.91	2.60
Totals		16	7	19	0	0	485.65	
	UP	4	0	2	0	0	54.25	7.37
Fitsum Cr.	L1	21	0	0	2	0	328.64	6.38
	L2	28	0	0	0	0	297.35	9.41
	L3	24	0	0	0	0	285.10	8.41
	L4	19	0	0	0	0	359.04	5.29
	L5	13	0	0	0	0	279.04	4.65
Totals		'105	0	0	2	0	1549.17	
	LP	16	0	0	0	0	142.35	11.23
Johnson Cr.	L1	41	0	0	7	0	1401.28	2.92
	L2	70	0	2	168	0	1720.22	4.06
	L3	45	2	0	127	0	1498.83	3.00
Totals		156	2	2	302	0	4620.33	

Appendix L. Continued.

Stream	Transect	Fish observed: Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Brook Trout	Surface area (m^2)	Steelhead per $100m^2$
<u>1984 Data Continued</u>								
Johnson Cr.								
	SP1	0	0	0	57	0	2482.40	0.00
	SP2	0	0	0	62	0	3403.77	0.00
	SP3	0	0	0	9	0	1915.26	0.00
Totals		0	0	0	128	0	7801.43	
[PW]	81	31	0	0	0	0	640.57	4.83
	82	14	0	0	0	0	678.20	2.06
	83	54	0	0	0	1	1693.29	3.18
Totals		99	0	0	0	1	3012.06	
(1YN)[5]	Al	0	0	0	0	36	393.19	0.00
	A2	0	0	0	0	14	459.94	0.00
Totals		0	0	0	0	50	853.13	
[MD][a]	Al	4	0	0	0	35	668.90	0.59
	A2	2	0	0	0	54	627.10	0.31
	A3	13	0	0	0	47	1588.64	0.81
Totals		19	0	0	0	136	2888.64	

Appendix L. Continued.

Stream	Transact	Fish observed					Surface area (m^2)	Steelhead per $100m^2$
		Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Brook Trout		
1984 Data Continued								
(RUN)[a]	Al	1	0	0	0	19	1556.72	0.06
	A2	9	0	0	0	6	825.19	1.09
	A3	2	D	0	0	1	687.04	0.29
Totals		12	0	0	0	26	3068.95	
(PW)	Al	8	2	0	0	4	1588.31	0.50
	A2	64	1	0	0	8	891.08	7.18
	A3	41	0	0	0	0	501.21	8.18
Totals		113	3	0	0	12	2980.60	
Lake Cr.	LI	5	0	6	11	0	532.07	0.93
	L2	4	0	1	31	7	367.05	1.08
	L3	4	0	5	10	7	354.12	1.12
	L4	1	0	3	9	8	413.25	0.24
	L5	1	0	5	53	5	264.94	0.37
	L6	1	0	0	28	6	344.43	0.29
	L7	0	0	0	16	4	198.13	0.00
Totals		16	0	15	158	42	2473.99	
Lick Cr.	LI	30	0	0	8	0	545.37	5.50
	L2	47	0	1	5	0	481.69	9.75
	L3	54	0	0	19	0	482.09	11.20

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Appendix L. Continued.

Stream	Transect	Fish observed ----- Steelhead parr	Cutthroat trout	Butt trout	Age 0 chinook salmon	Brook Trout	Surface area (m^2)	SteeLhead per $100m^2$
1984 Data Continued								
	L4	32	0	0	4	0	428.35	7.47
	L5	24	1	0	24	0	447.26	5.36
Totals		187	1	1	61	0	2384.76	
	L3	1	0	0	0	0	23.94	4.17
	LP	19	0	0	0	0	54.25	34.89
Porphyry Cr.	L1	9	0	0	0	0	698.25	1.28
	L2	16	0	0	0	0	113.85	14.05
	L3	23	0	0	0	0	92.61	24.83
	L4	9	0	0	0	0	109.96	8.18
	L5	6	0	0	0	0	92.35	6.49
Totals		63	0	0	0	0	1107.02	
Raines Cr.	LI	2	0	0	0	0	19.84	10.08
	L2	2	1	0	0	0	17.16	11.65
	L4	3	0	0	0	0	29.89	10.03
	L5	0	4	0	0	0	22.05	0.00
Totals		8	5	0	0	0	112.88	
Secesh River (Meadow)	AI	7	0	2	116	1	941.84	0.74
	A2	6	0	1	137	2	1426.46	0.42

Appendix L. Continued.

Stream	Transect	Fish observed						
		Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon^{--}	Brook Trout	Surface area (m^2)	Steelhead per $100m^2$
1984 Data Continued								
Secesh R. cont.	A3	4	0	0	162	11	1307.00	0.30
Totals		17	0	3	415	14	3675.30	
(Middle]	Al	40	0	0	44	0	1063.40	3.76
	A2	57	1	1	46	2	1639.38	3.47
	A3	29	0	0	13	1	919.18	3.15
Totals		126	1	1	103	3	3621.96	
Sheep Cr.	L1	11	0	0	0	0	135.66	8.10
	L2	7	0	0	0	0	106.00	6.60
	L3	18	0	0	0	0	139.81	12.87
	L4	16	0	0	0	0	137.99	11.59
	L5	11	0	0	0	0	80.10	13.73
Totals		63	0	0	0	0	599.56	
	LP	6	0	1	0	0	22.68	26.45
Trapper Cr.	L1	5	0	1	0	0	458.84	1.08
							46,003.67	

Appendix L . Continued.

Stream	Transect	Fish observed: Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Other	Surface area (m^2)	Steelhead per $100m^2$
1985 Data								
Buckhorn Cr.	Ul	12	0	6	0	0	194.9	6.15
	U2	4	0	10	0	0	252.4	1.58
	U3	7	0	2	0	0	226.2	2.09
	U4	0	0	24	0	0	297.0	0.00
	U5	0	1	16	0	0	151.7	0.00
Totals		23	1	58	0	0	1122.2	
W.Fk.	L1	30	0	0	65	0	231.0	12.98
	L2	24	0	0	19	0	188.2	12.75
	L3	14	2	0	0	0	239.0	5.85
	L4	14	1	0	0	0	177.1	7.90
	L5	9	2	0	0	0	217.4	4.14
Totals		91	5	0	84	0	1052.7	
W.Fk.	LP	17	0	0	1	0	47.1	36.07

Appendix L. Continued.

Stream	Transect	Fish observed: Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Other	Surface area (m^2)	Steelhead per $100m^2$
1985 Data Continued								
8urntlog Cr.	L1	0	0	0	20	0	410.6	0.00
	L2	0	0	0	0	0	308.0	0.00
	L3	0	0	0	5	0	309.8	0.00
	L4	0	0	0	2	0	268.1	0.00
	L5	0	0	0	0	0	358.0	0.00
Totals		0	0	0	27	0	1654.5	
	LP	0	0	0	12	0	138.2	0.00
	LBP	0	0	0	5	0	924.8	0.00
Caton Cr.	L1	5	0	0	0	0	155.5	3.21
	L2	8	0	0	0	0	127.2	6.28
	L3	15	0	0	0	0	193.6	7.74
	L4	7	0	0	0	0	169.5	4.12
	L5	20	0	0	0	0	221.0	9.04
Totals		55	0	0	0	0	866.8	
Elk Cr.	LI	32	0	0	0	0	810.2	3.94
	1.2	47	0	1	0	0	587.6	7.99
	L3	36	0	5	0	0	541.7	6.64
Totals		115	0	6	0	0	1939.5	

Appendix L. Continued.

Stream	Transact	Fish observed: Steethead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Other	Surface area (m^2)	Steelhead per $100m^2$
1985 Date Continued								
Elk Cr. Cont.	U1	2	0	0	0	0	130.2	1.53
	U2	0	0	0	0	0	140.4	0.00
	U3	0	0	0	0	0	214.0	0.00
Totals		2	0	0	0	0	484.8	
W.Fk.	L1	1	0	5	0	0	197.2	0.50
	L2	0	0	6	0	0	211.9	0.00
	L3	0	0	5	0	0	163.6	0.00
	L4	0	0	3	0	0	164.2	0.00
	L5	0	0	0	0	0	194.2	0.00
Totals		1	0	19	0	0	931.1	
Fitsum Cr.	U1	0	0	0	0	0	110.5	0.00
	U2	0	0	0	0	0	99.2	0.00
	U3	0	0	0	0	0	120.6	0.00
	U4	0	0	0	0	0	178.2	0.00
	U5	0	0	0	0	0	114.5	0.00
Totals		0	0	0	0	0	623.0	

Appendix L. Continued.

		Fish observed						
Stream	Transact	Steelhead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Other	Surface area (m^2)	Steelhead per $100m^2$
1985 Data Continued								
Fitsum Cr. Cont. N.Fk.	U1	14	0	1	0	0	282.7	4.95
	U2	7	0	0	0	0	188.2	3.71
	U3	0	0	8	0	0	247.1	0.00
	U4	0	0	9	0	0	238.8	0.00
	U5	0	0	0	0	0	178.9	0.00
Totals		21	0	18	0	0	1133.7	
Johnson Cr.	L1	50	3	0	17	0	1428.9	3.49
	L2	48	0	0	32	0	1354.3	3.54
	l3	46	0	1	20	3 HR	1371.2	3.35
Totals		144	3	1	69	3 HR	4154.4	
	SF1	0	0	0	30	0	1893.6	0.00
	SP2	0	0	0	115	0	2476.6	0.00
	SP3	0	0	0	135	0	1904.9	0.00
Totals		0	0	0	280	0	6275.1	

Appendix L. Continued.

Stream	Transact	Fish observed: Steethead parr	Cutthroat trout	Bull trout	Age 0 chinook salmon	Other	Surface area (m^2)	Steethead per $100m^2$
1985 Data Continued								
Lick Cr.	L1	20	0	0	24	0	454.6	4.39
	L2	62	0	0	30	0	428.7	14.46
	L3	56	1	0	20	0	342.4	16.35
	L4	35	0	1	0	0	455.0	7.69
	L5	28	0	0	20	0	300.0	9.33
Totals		201	1	1	94	0	1980.7	
	LP	15	0	0	12	0	50.7	29.60
Profile Cr.	LI	3	0	0	0	0	184.8	1.62
	L2	0	1	9	0	0	158.9	0.00
	L3	0	0	11	0	0	248.7	0.00
	L4	0	0	5	0	0	186.1	0.00
	L5	0	0	9	0	0	218.6	0.00
Totals		3	1	34	0	0	987.1	
	LP	0	0	7	0	0	111.6	0.00
	U1	0	0	9	0	0	173.6	0.00
	U2	0	2	10	0	0	172.8	0.00
	U3	0	0	10	0	0	217.8	0.00
	U4	0	6	4	0	0	114.7	0.00
	U5	0	3	3	0	0	109.3	0.00
Totals		0	11	36	0	0	788.2	

Appendix L. Continued.

Stream	Transect	Fish observed: Steelhead parr	Cutthroat trout	Bull trout	Age 0 Chinook salmon	Other	Surface Area (m^2)	Steelhead Per $100m^2$
1985 Data Continued								
Profile Cr. Cont.	UP	1	1	3	0	0	34.1	2.92
Quartz Creek	L1	1	0	8	0	0	243.8	0.41
	L2	0	0	9	0	0	204.8	0.00
	L3	0	0	5	0	0	149.8	0.00
	L4	0	0	11	0	0	250.8	0.00
	L5	0	0	10	0	0	264.8	0.00
Totals		1	0	41	0	0	1113.4	
Riordan Cr.	L1	18	0	0	0	0	170.6	10.55
	L2	19	0	0	0	0	185.4	10.24
	L3	16	0	0	0	0	151.8	10.54
	L4	53	0	0	0	0	289.1	19.69
	L5	20	0	1	0	0	165.2	12.18
Totals		126	0	1	0	0	941.1	

Appendix L. Continued.

Stream	Transect	Fish observed: Steelhead parr	Cutthroat trout	Bull trout	Age 0 Chinook salmon	Other	Surface Area (m^2)	Steelhead Per $100m^2$
<u>1985 Data Continued</u>								
Secesh R. (Middle)	M1	33	0	0	45	0	896.6	3.68
	M2	47	0	0	30	0	1789.0	2.62
	M3	26	0	0	15	1 BK	916.3	2.83
Totals		106	0	8	90	1 BK	3601.9	
Meadow Creek.	S1	5	0	0	165	0	1038.7	0.48
	S2	6	0	1	175	3 BK	1510.5	0.39
	S3	2	0	1	156	6 BK	1257.8	0.15
Totals		13	0	2	495	9 BK	3807.0	
Summit Cr.	L1	3	0	0	0	6 BK	285.7	1.04
	L2	0	0	0	0	23 BK	448.9	0.00
	L3	0	0	0	0	17 BK	283.9	0.00
	L4	0	0	0	0	20 BK	290.2	0.00
	L5	1	0	0	0	14 BK	302.5	0.33
Totals		4	0	0	0	80 BK	1611.2	

Appendix L. Continued.

Stream	Transact	Fish observed: Steelhead parr	Cutthroat trout	Bull	Age 0 chinook salmon	Other	Surface area (m²)	Steelhead per 100m²
1985 Data Continued								
Tamarack Cr.	L1	6	0	2	15	1 HR	286.2	2.09
	l2	10	0	3	6	0	238.3	4.19
	L3	1	0	4	0	0	236.3	4.19
	[illegible]	0	0	7	0	0	151.0	0.00
		0	0	15	0	0	161.4	0.00
						0		
Totals		17	0	31	21	1 HR	1073.2	
	LP	0	0	1	0	0	61.0	0.00

Other symbols: 8K – brook trout; HR – hatchery rainbow trout.

Appendix M. Length frequency of steelhead trout parr sampled by hook-and-line and electrofishing in South Fork Salmon River tributaries, July-September 1984 and 1985.

Length range (mm)	Bear Creek #1 1984	Bear Creek #1 1985	Bear Creek #2 1984	Blackmare Creek 1984	Blackmare Creek 1985	Buckhorn Creek 1984	Buckhorn Creek 1985	Buckhorn West Fork 1985	Burntlog Creek 1984	Burntlog Creek 1985	Camp Creek 1985
70-79	1	0	0	0	2	0	0	1	0	0	2
80-89	0	0	1	0	2	0	0	0	0	0	7
90-99	2	0	0	1	4	1	0	3	0	0	3
100-109	2	1	0	0	1	0	0	0	0	0	1
110-119	0	0	0	0	3	2	0	9	2	0	2
120-129	0	1	0	3	1	3	0	10	1	0	0
130-139	3	0	0	2	1	5	0	3	4	0	4
140-149	1	0	1	2	0	4	0	6	9	0	0
150-159	1	1	2	3	0	7	0	6	5	0	0
160-169	0	1	0	2	1	3	3	1	3	1	0
170-179	0	3	1	1	0	1	4	2	6	0	0
180-189	0	0	6	0	0	2	2	3	4	1	1
190-199	2	0	3	0	0	3	2	1	4	0	0
200-209	0	0	0	0	0	0	0	0	3	0	0
210-219	1	0	3	1	0	1	1	0	3	1	0
220-229	0	0	1	0	0	1	0	0	1	0	0
230-239	0	0	1	0	0	0	0	0	2	0	0
240-249	0	0	1	0	0	0	0	0	1	0	0
250-259	0	0	0	0	0	0	0	0	1	0	0
260-269	0	0	0	0	0	0	0	0	0	0	0
270-279	0	0		0	0	0	0	0	0	0	0
280-289	0	0		0	0	0	0	0	0	0	0
290-299	0	0		0	0	0	0	0	0	0	0
300-309	0	0		0	0	0	0	0	0	0	0
310-319	0	0		0	0	0	0	0	0	0	0
Total (N]	13	7	20	15	15	33	12	45	49	3	20

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Appendix M. Continued.

Length Range (mm)	Eaton Creek 1985	Cougar Creek 1985	Dollar Creek 1984	Dollar Creek 1985	Elk Creek 1985	Elk West Fork 1985	Fitsum Creek 1984	Fitsum North Fork 1985
70-79	0	0	0	0	1	0	0	0
80-89	0	0	0	4	0	0	1	0
90-99	2	1	0	1	1	0	0	0
100-109	1	4	0	0	0	0	1	0
110-119	4	2	2	0	0	0	5	0
120-129	3	3	2	1	2	0	10	1
130-139	7	1	7	1	6	0	12	2
140-149	5	1	4	1	6	0	9	2
150-159	1	1	1	0	7	0	6	1
160-169	2	1	0	0	5	0	7	2
170-179	2	0	3	0	9	0	10	2
180-189	0	0	1	1	4	0	8	0
190-199	0	0	0	1	4	1	7	0
200-209	0	0	2	0	4	0	5	0
210-219	0	0	0	1	4	0	2	0
220-229	0	0	0	0	1	0	2	0
230-239	0	0	0	0	1	0	1	0
140-249	0	0	0	0	0	0	0	0
250-259	0	0	0	0	1	0	0	0
260-269	0	0	0	0	0	0	0	0
270-279	0	0	0	0	0	0	0	0
280-289	0	0	0	0	0	0	0	0
290-299	0	0	0	0	0	0	0	0
300-309	0	0	0	0	0	0	0	0
310-319	0	0	0	0	0	0	0	0
Total (N)	31	14	22	11	56	1	86	9

Appendix M. Continued.

Length range (mm)	Johnson Creek 1984	Johnson Creek 1985	Lick Creek 1984	Lick Creek 1985	Phoebe Creek 1985	Porphyry Creek 1984	Profile Creek 1984	Profile Creek 1985	Quartz Creek 1985	Riordan Creek 1984	Riordan Creek 1985
70–79	0	0	0	1	4	0	0	0	0	0	2
80-89	0	6	4	1	17	0	0	0	0	0	3
90-99	0	11	13	0	5	0	0	0	0	0	3
100-109	0	9	14	3	3	1	0	0	0	0	2
110-119	1	12	13	4	2	0	0	0	0	0	11
120-129	2	8	25	4	0	0	0	0	0	4	8
130-139	0	5	36	6	3	1	0	1	0	5	10
140-149	3	8	25	12	1	0	0	1	0	2	3
150-159	4	6	23	8	0	0	0	0	0	3	7
160-169	8	16	19	6	0	1	0	1	0	2	2
170-179	2	7	18	3	0	0	0	2	0	1	3
180-189	4	10	10	3	0	0	0	1	0	0	1
190-199	0	5	10	5	0	1	0	1	0	0	2
200-209	1	6	5	1	0	0	0	1	0	3	0
210-219	0	0	2	1	0	1	1	2	0	0	0
220-229	1	0	3	0	0	0	1	0	0	2	0
230–239	0	1	0	0	0	0	0	1	0	2	2
240-249	0	0	1	0	0	0	0	0	0	0	0
250-259	0	0	0	0	0	0	0	0	0	1	0
260-269	0	0	0	0	0	0	0	0	1	0	0
270–279	0	0	0	0	0	0	0	1	0	0	0
280-289	0	0	0	0	0	0	0	0	0	0	0
290-299	0	0	0	0	0	0	0	0	0	0	0
300-309	0	0	0	0	0	0	0	0	0	0	0
310–319	0	0	0	0	0	0	0	0	0	0	0
Total [N]	26	110	221	58	35	5	2	12	1	25	59

Appendix M. Continued.

Length range [mm)	Secesh River 1984	Secesh River 1985	Sheep Creek 1984	Sugar Creek 1985	Summit Creek 1985	Tamarack Creek 1984	Tamarack Creek 1985	Trapper Creek 1984	Trapper Creek 1985
70-79	0	0					0	0	0
80-89	3	0					0	0	2
90-99	3	0					0	1	3
100-109	2	3					0	2	1
110-119	0	3					0	0	1
120-129	1	2					3	0	0
130-139	5	7					4	0	0
140-149	5	8					2	0	1
150-159	8	7					2	1	1
160-169	15	10					4	0	1
170-179	20	13					3	0	0
180-189	17	14					1	0	1
190-199	11	13					2	1	0
200-209	5	14					0	0	0
210-219	1	5					1	0	0
220-229	4	5					2	0	0
230-239	1	2					0	0	1
240-249	1	0					0	0	0
250-259	0	1					0	0	0
260-269	0	1					0	0	0
270-279	0	0					0	0	0
280-289	0	0					0	0	0
290-299	0	0					0	0	0
300-309	0	0					0	0	0
310-319	0	0					1	0	0
Total (N)	102	108	15	3	5	15	25	5	12

Appendix N. Length frequency of bull trout sampled by hook-and-line and electrofishing in South Fork Salmon River tributaries, July-September 1984 and 1985.

Length range (mm)	Blackmare Creek 1985	Buckhorn Creek 1984	Buckhorn Creek 1985	Buckhorn west fork 1985	Burntlog Creek 1984	Camp Creek 1985	Cougar Creek 1985	ElkFitsum west Fork 1985	ElkFitsum north fork 1985
60-69	0	0	0	0	0	0	0	0	0
70-79	0	0	0	0	0	0	0	0	0
80-89	0	0	0	0	0	0	0	0	0
90-99	0	0	0	0	1	0	0	0	0
100-109	0	0	0	0	1	0	0	0	0
110-119	0	0	0	0	0	0	0	0	0
120-129	0	0	0	0	0	1	0	0	0
130-139	0	0	0	0	1	0	0	0	0
140-149	0	1	2	0	0	0	0	0	1
150-159	0	1	2	0	0	0	0	2	0
160-169	0	5	2	1	1	0	1	1	0
170-179	0	0	5	0	0	0	0	3	0
180-189	1	0	1	0	1	0	0	0	0
190-199	0	1	2	0	0	0	0	1	0
200-209	0	1	1	0	0	0	0	1	0
210-219	0	1	0	0	2	0	0	0	0
220-229	0	0	0	0	0	0	0	0	0
230-239	0	0	0	0	0	0	0	0	0
240-249	0	0	0	0	0	0	0	0	0
250-259	0	0	0	0	0	0	0	0	1
260-269	0	0	0	0	0	0	0	0	0
270-279	0	0	0	0	0	0	0	0	0
280-289	0	0	0	0	0	0	0	0	0
290-299	0	0	0	0	0	0	0	0	0
400-409	0	0	0	0	0	0	0	0	0
450-459	0	0	0	0	0	0	0	0	0
460-469	0	0	0	0	0	0	0	0	0
480-489	0	0	0	0	0	0	0	0	0
Total (N)	1	10	15	1	7	1	1	8	2

Appendix N. Continued.

Length range (mm)	Lick Creek 1984	Lick Creek 1985	Profile Creek 1984	Profile Creek 1985	Quartz Creek 1984	Quartz Creek 1985	Secesh River 1984	Sugar Creek 1985	Tamarack Creek 1984	Tamarack Creek 1985	Trapper Creek 1984	Trapper Creek 1985
60-69			0	0			0			0	0	2
70-79			0	0			0			0	0	8
80-89			0	0			0			0	0	1
90-99			0	0			0			0	0	3
100-109			0	1			0			0	0	6
110-119			0	3			0			0	0	7
120-129			2	11			0			0	0	2
130-139			0	4			0			2	2	3
140-149			0	7			0			1	1	1
150-159			0	6			0			0	1	4
160-169			1	4			0			0	5	1
170-179			4	7			0			2	14	3
180-189			3	5			1			2	9	3
190-199			3	0			0			1	2	0
200-209			3	2			0			1	4	0
210-219			3	0			0			2	2	0
220-229			2	0						0	1	0
230-239			0	0						1	0	0
240-249			0	2						1	1	0
250-259			0	1						0	0	0
280-269			0	0						0	0	0
270-279			0	0						1	0	0
280-289			0	0						0	0	0
290-299			0	0						0	0	0
400-409			0	1						0	0	0
450-459			0	0						0	0	0
460-469			0	0						1	0	0
480-489			0	0						0	0	0
Total (N)	2	1	21	54	20	20	1	35	2	15	42	44

Appendix O. Length frequency of chinook salmon sampled by hook-and-line and electrofishing in South Fork Salmon River tributaries, July-September 1984 and 1985.

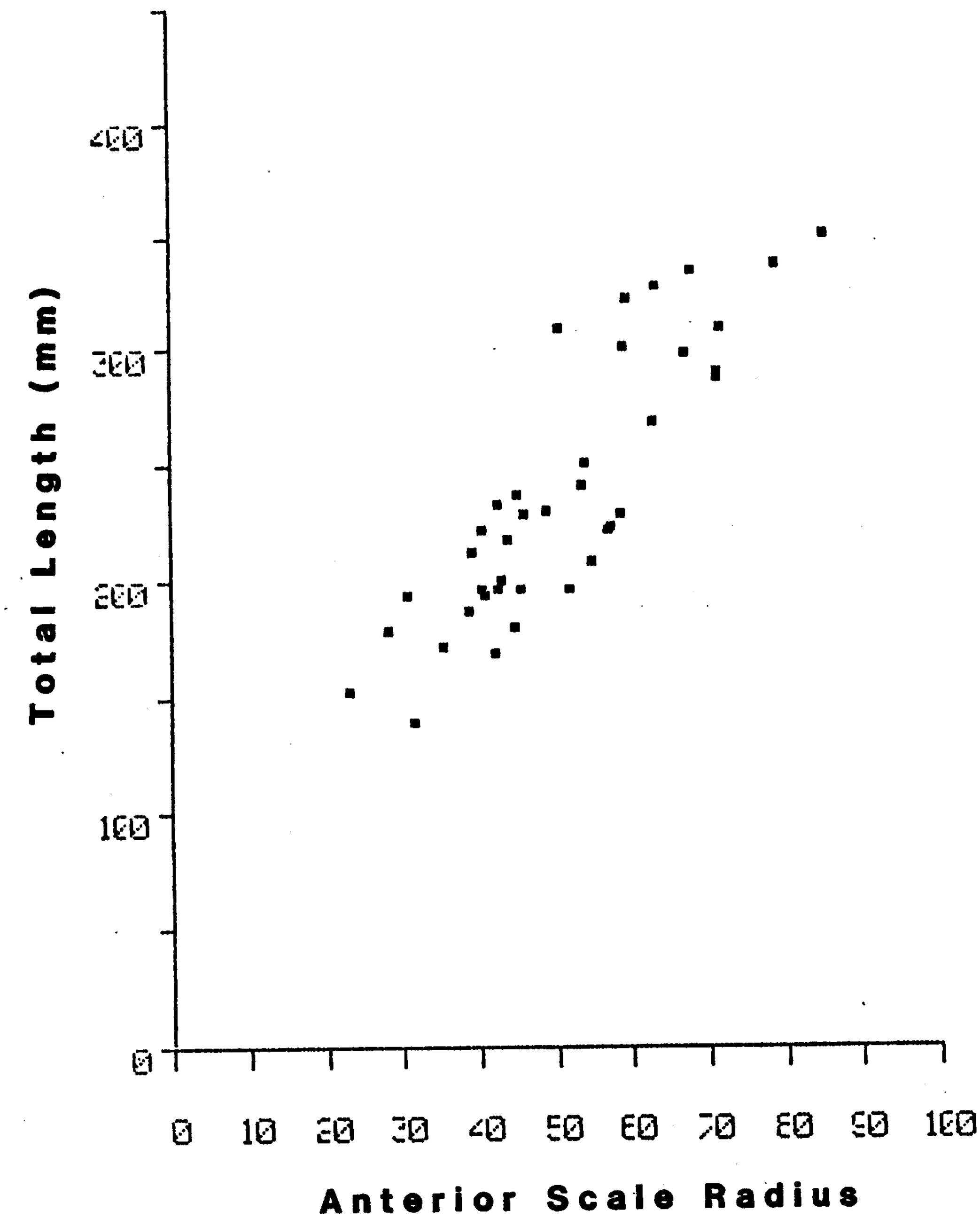
Length range (mm)	Beer Creek 1985	Blackmere Creek 1985	BurntLog Creek 1984	Camp Creek 1985	Cougar Creek 1985	Johnson Creek 1984	Johnson Creek 1985
50-59	0	1	0	3	1	0	0
60-69	0	5	0	5	5	0	0
70-79	1	7	0	0	3	1	4
80-89	0	0	0	1	0	0	4
90-99	3	1	0	0	0	0	0
100-109	1	0	2	0	0	0	1
110-119	0	0	0	0	0	0	3
120-129	0	0	0	0	0	0	2
130-139	0	0	0	0	0	0	0
140-149	0	0	0	0	0	0	0
150-159	0	0	0	0	0	0	0
160-169	0	0	0	0	0	0	0
Total (N)	5	14	2	9	9	1	14

Appendix O. Continued.

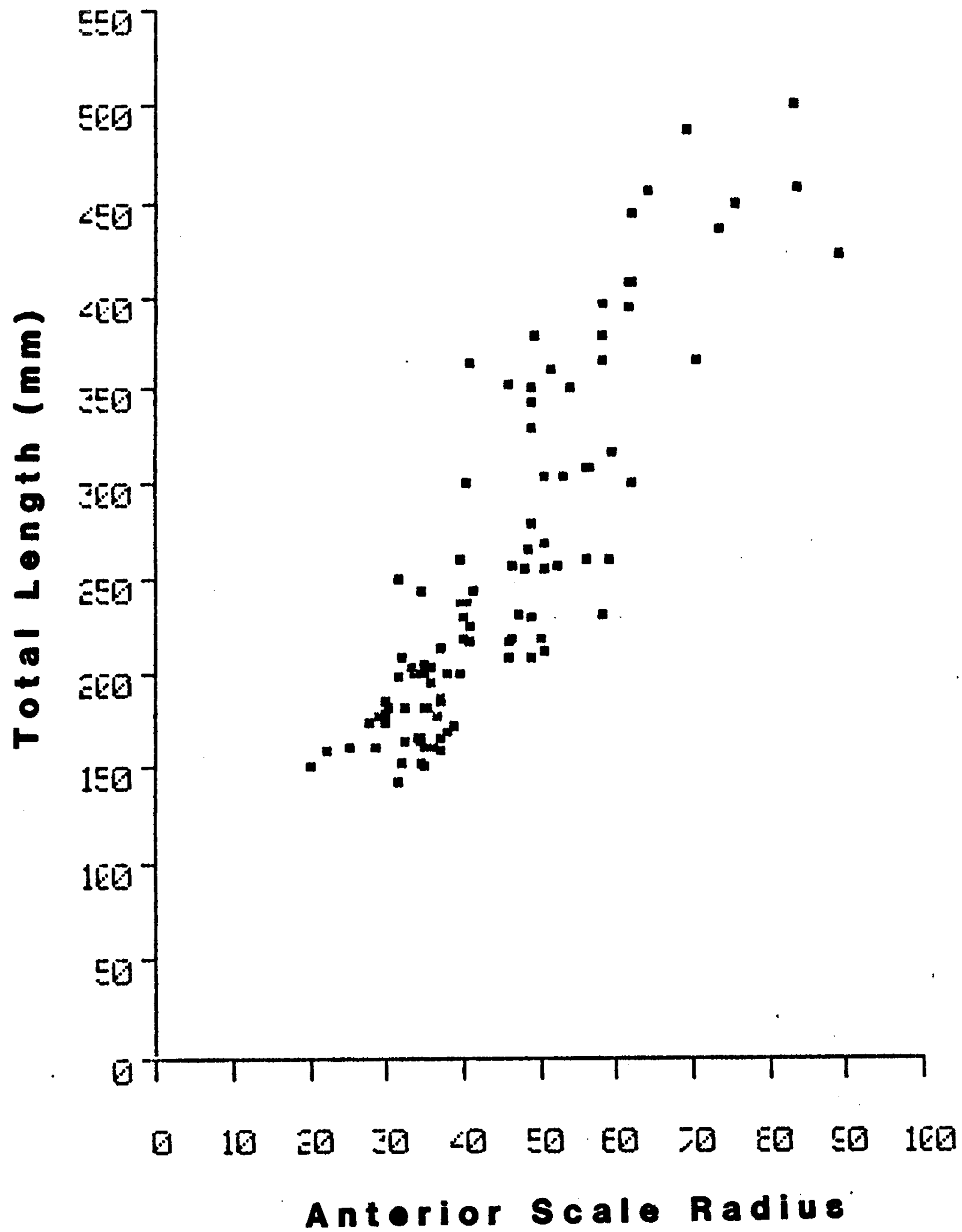
Length range (mm)	Lick Creek 1984	Lick Creek 1985	Phoebe Creek 1985	Secesh River 1984	Secesh River 1985	Trapper Creek 1985
50-59	0	0	2	0	0	0
60-69	0	0	14	3	0	0
70-79	2	0	3	7	0	0
80-89	1	0	0	1	0	1
90-99	0	0	0	0	1	1
100-109	1	0	0	0	3	0
110-119	3	2	0	5	8	0
120-129	1	1	0	0	6	0
130-139	0	0	0	0	0	0
140-149	0	0	0	0	0	0
150-159	0	0	0	0	0	0
160-169	0	0	0	0	1	0
Total (N]	8	3	19	16	19	2

Appendix P. Length frequency of cutthroat trout sampled by hook-and-Line end electrofishing in South Fork Salmon River tributaries, July-September, 1984 and 1985.

Length range (mm)	Bear Creek		Burntlog Creek	Camp Creek	Dollar Creek	Fitsum Creek	Johnson Creek	Phoebe Creek	Profile Creek		Tamarack Creek
	1984	1985	1984	1985	1984	1984	1984	1985	1984	1985	1984
70-79	0	1	0	0	0	0	0	0	0	0	0
80-89	0	1	0	0	0	0	0	1	0	0	0
90-99	0	2	0	0	0	0	0	0	0	0	0
100-109	0	3	0	0	0	0	0	0	0	0	0
110-119	0	1	0	0	0	0	0	1	0	0	0
120-129	0	1	0	0	0	1	0	0	0	0	0
130-139	0	2	1	1	0	0	0	0	0	1	0
140-149	0	1	0	2	0	0	1	0	0	2	0
150-159	1	1	0	0	0	1	0	0	0	2	0
160-169	0	0	3	0	1	1	0	0	0	3	0
170-179	0	1	5	0	0	0	0	0	0	2	0
180-189	0	1	6	0	1	0	0	0	1	3	1
190-199	0	1	3	0	1	0	1	0	0	1	1
200-209	0	0	0	0	1	0	0	0	2	2	0
21 0-219	0	0	1	0	0	0	0	0	1	1	0
220-229	0	0	1	0	0	0	0	0	0	0	0
230-239	0	0	1	0	0	0	0	0	0	0	0
240-249	0	0	2	0	0	0	0	0	0	0	0
Total (N)	1	16	23	3	4	3	2	2	4	17	2



Appendix Q. Anterior scale radius versus total length for cutthroat trout from the South Fork Salmon River, 1985.



Appendix R. Anterior scale radius versus total length for bull trout from the South Fork Salmon River, 1985.

Appendix S. Estimated effort for bank anglers by census interval on the South Fork Salmon River, 1984 and 1985 (95% error bound in parentheses)

Estimated angler hours by Section + [Error Bound)

Interval	Section 1		Section 2		Section 3		Section 4		Section 5	
<u>1984 Data</u>										
6/30 to 7/13	91.98	(137.12)	298.94	(260.97)	145.64	(187.13)	252.95	(322.03)	222.29	(143.54)
7/14 to 7/27	CS		328.90	(319.24)	667.77	(343.24)	279.07	(260.26)	413.62	(213.06)
7/28 to 8/10	CS		202.02	(262.40)	447.33	(202.02)	456.95	(316.29)	81.77	(125.06)
8/11 to 8/24	CS		225.73	(267.19)	681.79	(337.51)	732.46	[549.80)	299.43	(211.91)
8/25 to 9/07	CS		0.00	(0.00)	184.38	(120.13)	138.29	(101.73)	26.34	(37.25)
9/08 to 9/21	CS		37.44	(47.79)	37.44	(47.79)	162.24	(254.13)	12.48	(24.96)
Total	91.98	(137.12)	1093.03	(1339.76)	2164.35	(1237.82)	2021.96	(1804.26]	1055.93	[755.78)
Pooled interval total	91.98	(137.12)	1135.39	(569.46)	2291.67	(697.38)	1957.58	(839.40)	1076.24	(417.93)
GRAND TOTAL	6552.86	(2661.29)								

CS = closed season (to protect spawning chinook salmon).

Appendix S. Continued.

Estimated angler hours by Section + [Error Bound)

Interval	Section 2A		Section 2B		Section 3		Section 4		Section 5A		Section 5B	
1985 Data												
5/25 to 6/07											7.60	(15.20)
6/08 to 6/21											133.73	(144.01)
[illegible]											177.33	(145.47)
											111.32	(94.93)
											771.92	(514.44)
											614.47	(385.16)
											212.28	(234.34)
											90.09	(57.56)
	358.57	(566.53)	1,435.87	(1,367.35)	4,096.11	(2,716.22)	2,905.23	(2,331.42)	205.69	(243.91)	2,118.74	(1,591.11)

GRAND TOTAL (SEC 2A-5B = 11,120.21(8,816.54)

Pooled interval total	336.93	(312.48)	1,425.78	[620.48)	4,272.13	(1,424.93)	3,191.87	(1,331.33)	213.37	[198.98)	2,194.87	(936.59)

GRAND TOTAL (Pooled Sec 2A-58) =
11,634.95

CS = closed season (to protect spawning chinook salmon).

Appendix T. Harvest information collected on the South Fork Salmon River, 1984 and 1985.

Section	Interval	Anglers interviewed	Hours fished	Total fish Harvest	Total fish Release	Catch rate (fish/hour) Harvest	Catch rate (fish/hour) Release	Catch rate (fish/hour) Total	Harvest by species: Steelhead parr	Wild rainbow trout	Cutthroat trout	Hatchery rainbow	Bull trout	Mountain white-fish
<u>1984 Data</u>														
1	I	13	11.00	1	0	0.09	0.00	0.09	1	0	0	0	0	0
2	I	8	8.50	3	4	0.35	0.47	0.82	0	0	0	0	1	1
	II	18	21.50	20	19	0.93	0.88	1.81	0	0	1	0	0	0
	III	3	2.00	1	0	0.50	0.00	0.50	1	0	0	0	0	0
	IV	15	18.50	11	37	0.56	1.90	2.46	10	1	0	0	0	0
	V	8	19.00	13	3	0.68	0.16	0.84	8	0	1	0	1	2
	VI	11	25.25	11	5	0.44	0.20	0.64	3	1	1	0	5	1
Total		63	95.75	59	68	0.62	0.71	1.33	22	2	3	0	7	41
3	I	9	21.00	4	3	0.19	0.14	0.33	0	0	0	1	0	0
	II	33	54.50	50	18	0.92	0.33	1.25	17	1	0	25	6	1
	III	26	49.00	31	33	0.63	0.67	1.31	7	0	1	19	0	1
	IV	36	103.00	59	73	0.57	0.71	1.28	11	2	1	23	3	0
	V	12	29.00	27	14	0.93	0.48	1.41	0	0	1	0	4	0
	VI	4	1.25	3	1	2.40	0.80	3.20	0	0	0	0	0	0
Total		120	257.75	174	142	0.68	0.55	1.23	35	3	3	68	13	2
4	I	8	7.00	10	3	1.42	0.43	1.86	1	0	0	9	0	0
	II	3	2.00	4	0	2.00	0.00	2.00	0	0	0	3	1	0
	III	21	29.50	24	38	0.81	1.29	2.10	3	1	0	17	3	0
	IV	17	33.00	32	15	0.97	0.45	1.42	9	1	0	14	2	1
	V	14	13.75	13	14	0.94	1.02	1.96	0	0	0	0	0	0

Section	Interval	Anglers inter- viewed	Hours fished	To Harvest	To Release	Catch Harvest	Catch Release		Steelhead		Cutthroat trout	Hatchery	Bull	Mountain white rai nbo
1984 Data Continued														
	VI	8	9.00	8	2	0.89	0.22	1.11	0	0	0	0	2	0
Total		71	94.25	91	72	0.97	' 0.76	1.73	13	2	0	43	8	1
5	I		10.50			0.19	0.48	0.67						0
	II		18.00			1.22	0.94	2.17						0
	III		19.50			1.33	1.49	2.82						0
	IV		3.25			1.54	2.77	4.31						0
	V		0.25			0.00	0.00	0.00						0
	VI	1	6.00	3	0	0.50	0.00	0.50	3	0	0	0	0	0
Total		49	57.70	58	60	1.01	1.04	2.05	16	1	37	2	0	0
Secesh	I		0.50			0.00	0.00	0.00						0
	II		20.00			0.40	0.45	0.85						0
	III		9.00			2.00	2.44	4.44						2
	IV		15.50			0.58	0.26	0.84						0
	V		6.00			2.50	1.33	3.83						0
	VI	1	2.00	0	0	0.00	0.00	0.00	0	0	0	0	0	0
Total		25	53.00	50	46	0.94	0.87	1.81	23	0	0	18	0	2
Profile	IV	2	6.00	1	10	0.17	1.67	1.83	0	0	1	0	0	0
GRAND TOTAL		343	575.25	434	398	0.75	0.69	1.45	110	8	7	166	30	9

Appendix T. Continued.

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Section	Interval	Anglers inter- viewed	Hours fished	To ta Harvest	Release	Catch rate (fish/hour) Harvest	Release	Total	Harvest by species Steelhead	rainbow trout	Cutthroat trout	Hatchery	Bull	Mountain white-rai nbo
1885 Data														
2A	1		8.00			0	0	0			0	0		0
	II		13.75			0.07	0.58	0.65			0	0		0
	III		39.50			0.89	0.96	1.85			0	0		0
	IV	18	60.66	23	65	0.38	1.07	1.45	0	0	1	0	0	0
Total			121.91			x3.48	0.91	1.39		4	1	0	3	0
2B	I		8.00			0.13	0.13	0.25			0	0		0
	II		41.08			0.22	0.29	0.51			1	0		1
	III		70.49			0.21	1.12	1.33			1	0		0
	IV		34.32			0.52	2.27	2.80			2	3		0
	V		20.99			0.52	1.38	1.90			1	0		3
	VI		2.75			1.82	0	1.82			0	0		1
	VII		25.75			0.35	3.07	3.42			2	0		2
	VIII	13	9.49	3	8	0.32	0.84	1.16	2	1	0	0		0
Total			212.87			x . 3 3	1.34	1.68		5	7	3	6	7
Total for 2A & 2B			334.78			x . 3 9	1.18	1.57		9	8	3	9	7
3	I		14.00			0.36	0	0.36		0	0	0		0
	II		15.00			0.73	0.53	1.27			0	0		0
	III		119.41			0.58	0.78	1.36			3	2		1
	IV		113.81			1.19	1.66	2.85			0	1		0
	V		195.24			0.71	1.28	1.99			B	3		3

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Appendix T. Continued.

Section	Interval	Anglers inter-viewed	Hours fished	Total fish Harvest	Total fish Release	Catch rate (fish/hour) Harvest	Catch rate (fish/hour) Release	Catch rate (fish/hour) Total	Steelhead parr	Harvest by species: Wild rainbo trout	Cutthroat trout	Hatchery rainbow	Bull trout	Mountain white-fish
<u>1985 Data</u>														
3	VI	30	51.75	54	79	1.04	1.53	2.57	36	2	2	0	6	1
	VII	34	49.25	25	54	0.51	1.10	1.60	9	0	1	1	2	0
	VIII	34	64.49	18	17	0.28	0.26	0.54	10	3	0	0	3	1
Total		334	622.95	456	691	x.73	1.11	1.84	242	28	14	7	39	6
4	I	5	17.00	1	0	0.06	0	0.06	0	0	0	0	1	0
	II	6	2.25	0	1	0	0.44	0.44	0	0	0	0	0	0
	III	22	28.50	10	34	0.35	1.19	1.54	0	0	0	4	3	0
	IV	18	38.50	40	47	1.04	1.22	2.26	20	1	0	8	6	0
	V	59	103.24	45	100	0.44	0.97	1.40	16	0	0	25	2	0
	VI	37	59.74	79	124	1.32	2.08	3.40	43	7	0	22	3	4
	VII	44	89.81	73	85	0.81	0.95	1.76	32	5	2	32	2	0
	VIII	14	26.75	28	11	1.05	0.41	1.46	7	• 1	1	19	0	0
Total		205	365.78	278	392	x.75	1.07	1.83	118	14	3	110	17	4
<u>1985 Data Continued</u>														
5A	II	7	1.08	0	0	0	0	0	0	0	0	0	0	0
	III	32	74.50	25	18	0.34	0.24	0.58	0	0	0	5	0	2
	IV	4	4.00	1	31	0.25	7.75	8.00	1	0	0	0	0	0
Total		43	79.58	26	49	x.33	0.62	0.94	1	0	0	5	0	2

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Appendix T. Continued.

Section	Interval	Anglers inter- viewed	Hours fished	Total fish Harvest	Total fish Release	Catch rate (fish/hour) Harvest	Catch rate (fish/hour) Release	Catch rate (fish/hour) Total	Harvest by species: Steelheed parr	Wild rainbow trout	Cutthroat trout	Hatchery rainbow	Bull trout	Mountain white fish
5B	II	2	0.50	0	0	0	0	0	0	❑	0	0	0	0
	III	24	76.00	37	62	0.49	0.82	1.30	24	3	1	7	0	0
	IV	14	18.75	33	45	1.76	2.40	4.16	27	1	0	1	0	0
	V	58	81.58	89	143	1.09	1.75	2.84	46	1	0	13	0	1
	VI	21	34.50	32	51	0.93	1.48	2.41	11	❑	0	9	1	3
	VII	23	52.96	22	35	0.42	0.66	1.08	2	❑	0	12	0	0
	VIII	2	4.33	0	0	0	0	0	0	❑	0	0	0	0
Total		144	268.62	213	336	x- .79	1.25	2.04	110	5	1	42	1	4
Total for 5A & 5B		187	348.2	239	385	x- .69	1.10	1.79	111	5	1	47	1	6
GRAND TOTAL		908	1,671.72	1,101	1,865	0.66	1.12	1.78	509	56	26	167	66	23

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